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(21) International Application Number: PCT/NO97/00100 (22) International Filing Date: 16 April 1997 (16.04.97) (30) Priority Data: 961526                      17 April 1996 (17.04.96)      NO 965418                      17 December 1996 (17.12.96)      NO (71) Applicant (for all designated States except US): UNIFOB [NO/NO]; Stiftelsen Universitetsforskning Bergen, Prof. Keyzersgt 8, N-5020 Bergen (NO). (72) Inventors; and (75) Inventors/Applicants (for US only): ANDERSEN, Øyvind, Moksheim [NO/NO]; Kråvasslia 273, N-5091 Flaktveit (NO). HELLAND, Dag, Emil [NO/NO]; Hatlestad terr. 30, N-5050 Nestun (NO). ANDERSEN, Knut, Jan [NO/NO]; Eikebakken 7, N-5035 Bergen-Sandviken (NO). (74) Agent: A/S BERGEN PATENTKONTOR; Strandgt. 191, N-5004 Bergen (NO).		(81) Designated States: AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CU, CZ, DE, DK, EE, ES, FI, GB, GE, HU, IL, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, TJ, TM, TR, TT, UA, UG, US, UZ, VN, YU, ARIPO patent (GH, KE, LS, MW, SD, SZ, UG), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, ML, MR, NE, SN, TD, TG).  Published With international search report. Before the expiration of the time limit for amending the claims and to be republished in the event of the receipt of amendments.	
(54) Title: USE OF ANTHOCYANIDIN AND ANTHOCYANIDIN DERIVATIVES			
<div style="text-align: center;"> </div> <p style="text-align: right;">(I)</p>			
(57) Abstract			
<p>The invention relates to the use of an anthocyanidin or an anthocyanidin derivative of general formula (I) wherein R<sub>1</sub>, R<sub>2</sub>, R<sub>3</sub> and R<sub>6</sub> independently of each other is H, OH, alkoxy, an -O-glycosyl group, an -O-glycosyl group which is substituted with one or more acyl groups, or an -O-glycosyl moiety comprising at least two glycosyl groups and at least one acyl group arranged so that at least one acyl group is located between two glycosyl groups, R<sub>4</sub> is OH, alkoxy, an -O-glycosyl group, an -O-glycosyl group which is substituted with one or one acyl groups, or an -O-glycosyl moiety comprising at least two glycosyl groups and at least one acyl group arranged so that at least one acyl group is located between two glycosyl groups, R<sub>5</sub> is H, OH, and Y is a counterion or a salt, prodrug, a chemical modification or complex thereof for the preparation of a pharmaceutical composition for the prevention and/or treatment of neoplastic disorders, diseases caused by lesions in connective tissues or a disease caused by a virus in a mammal including a primate such as a human, as well as to novel anthocyanin derivatives of general formula (I) and methods for preparation of said compounds, novel pharmaceutical compositions and methods of treating retroviral infections.</p>			

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## USE OF ANTHOCYANIDIN AND ANTHOCYANIDIN DERIVATIVES

The present invention relates to the use of an anthocyanidin or an anthocyanidin derivative of the general formula I or a pharmaceutically acceptable salt, prodrug or complex thereof for the preparation of a pharmaceutical composition for the prevention and/or treatment of neoplastic disorders, diseases caused by lesions in connective tissues or a disease caused by a virus in a mammal including a primate such as a human.

## BACKGROUND OF THE INVENTION

Anthocyanins are the most important group of water-soluble plant pigments visible to the human eye. As the anthocyanins seem to have non-toxic effects on the human being, their possible pharmaceutical use has been further investigated.

In PCT/NO95/00185 the present inventors have disclosed that an anthocyanidin or an anthocyanidine derivative is useful for the prevention or treatment of a disease caused by a retrovirus such as, e.g., HIV-1 and HIV-2. The inventors contemplate that the anthocyanidin or anthocyanidin derivatives inhibits the reverse transcriptase or HIV integrase encoded by human immunodeficiency virus (HIV) type 1 (HIV-1) and type 2 (HIV-2). Based upon further experimentation, the present inventors have now found that anthocyanidin or anthocyanidin derivatives and pharmaceutically acceptable salts thereof exhibit very

promising effect also against other types of viruses than retrovirus and against neoplastic disorders and diseases caused by lesions in connective tissues.

## 5 DETAILED DESCRIPTION OF THE INVENTION

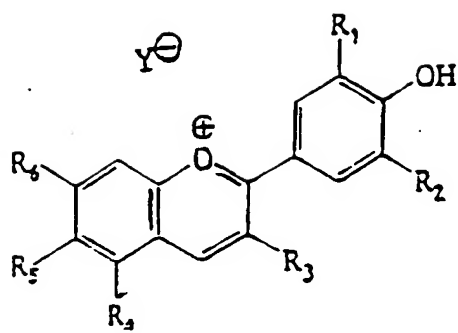
The present invention discloses that anthocyanidin and anthocyanidin derivatives can exhibit antiviral effects in infected cells and that they exhibit antineoplastic effects  
10 in neoplastic cells. Further, the present invention discloses that anthocyanidin and anthocyanidin derivatives can inhibit the degradation of the extracellular matrix and connective tissues. A very important feature by the anthocyanidins and anthocyanidin derivatives is that it has  
15 been found that the anthocyanidins and anthocyanidin derivatives are substantially harmless to mammalian cells in concentrations at which they effectively exert the antineoplastic or antiviral effect. This selectivity is very surprising.

20

In the present context the term "anthocyanidin" denotes an aglycone of an anthocyanin and the term "anthocyanidin derivative" denotes any derivative of an anthocyanidin including any anthocyanin as well as a derivative of an  
25 anthocyanin and a derivative of an aglycone of an anthocyanin (i.e. a derivative of an anthocyanidin).

The present invention relates to the use of an anthocyanidin or an anthocyanidin derivative of the general  
30 formula I





wherein

5 R<sub>1</sub>, R<sub>2</sub>, R<sub>3</sub> and R<sub>6</sub> independently of each other are H, OH, C<sub>1-6</sub>-alkoxy, an -O-glycosyl group, an -O-glycosyl group which is substituted with one or more acyl groups, or an -O-glycosyl moiety comprising at least two glycosyl groups and at least one acyl group arranged so that at least one acyl group is  
10 located between two glycosyl groups,

R<sub>4</sub> is OH, alkoxy, an -O-glycosyl group, an -O-glycosyl group which is substituted with one or one acyl groups, or an -O-glycosyl moiety comprising at least two glycosyl groups and  
15 at least one acyl group arranged so that at least one acyl group is located between two glycosyl groups,

R<sub>5</sub> is H, OH, and

20 Y is a counterion,

or a prodrug, a chemical modification or complex thereof for the preparation of a pharmaceutical composition for the prevention and/or treatment of neoplastic disorders,

diseases caused by lesions in connective tissues or a disease caused by a virus in a mammal including a primate such as a human.

5 In particular, the invention relates to the use of a compound wherein at least one of  $R_1$ ,  $R_2$ ,  $R_3$ ,  $R_4$ , and  $R_6$  is an -O-glycosyl group, an -O-glycosyl group which is substituted with at least one acyl group, or an -O-glycosyl moiety comprising at least two glycosyl groups and at least  
10 one acyl group arranged so that at least one acyl group is located between two glycosyl groups. The -O-glycosyl moiety may comprise at least two glycosyl groups and at least one acyl group arranged alternate with one glycosyl followed by one acyl group; an acyl group may also be located at the  
15 very end of the moiety.

Several anthocyanins are commercially available. However, many of these anthocyanins can undergo decomposition in a medium having a pH in a range corresponding to the  
20 physiological pH range (i.e. about 5-9) and may therefore prove to be difficult to present as a stable pharmaceutical composition. The present inventors have found that more stable anthocyanins are obtained if  $R_3$  in formula I is an -O-glycosyl group which is substituted with at least one  
25 acyl group, or an -O-glycosyl moiety comprising at least two glycosyl groups and at least one acyl group arranged so that at least one acyl group is located between two glycosyl groups. The -O-glycosyl moiety may comprise at least two glycosyl groups and at least one acyl group  
30 arranged alternate with one glycosyl followed by one acyl

group; an acyl group may also be located at the very end of the moiety. Therefore, the invention also relates to the use of a compound wherein  $R_3$  is as defined above.

5 The compounds of formula I can also be chemically modified by known methods for instance to increase the stability of the compounds. Therefore, the invention also relates to the use of a compound of formula I which is chemically modified to increase the stability.

10

A presently preferred embodiment of the invention is the use of the compound petanin wherein, with reference to formula I,  $R_1$  is  $OCH_3$ ,

$R_2$  is OH,

15  $R_3$  is 6-O-(4-O-E-p-coumaroyl- $\alpha$ -L-rhamnopyranosyl)- $\beta$ -D-glucopyranosyl,

$R_4$  is  $\beta$ -D-glucopyranosyl,

$R_5$  is H,

and  $R_6$  is OH.

20

Other presently preferred embodiments are the use of the individual anthocyanins outlined in Tables I and II below, e.g. in compositions wherein the relative quantities of the various anthocyanins are as outlined in Table I or Table

25 II.

TABLE I

Structures and relative proportions (%) of the individual anthocyanins in the first purified *Vaccinium myrtillus* sample 5 (sample VA-1) with reference to formula I,  $R_4$  is OH,  $R_5$  is H and  $R_6$  is OH

COMPOUND	$R_1$	$R_2$	$R_3$	Proportions (%)
10 1. Delphinidin-3-galactoside	OH	OH	-O-galactosyl	10.6
2. Delphinidin-3-glucoside	OH	OH	-O-glucosyl	10.7
15 3. Cyanidin-3-galactoside	OH	H	-O-galactosyl	6.8
4. Delphinidin-3-arabinoside	OH	OH	-O-arabinosyl	10.6
5. Cyanidin-3-glucoside	OH	H	-O-glucosyl	8.1
20 6. Petunidin-3-galactoside	OCH <sub>3</sub>	OH	-O-galactosyl	4.6
7. Cyanidin-3-arabinoside	OH	H	-O-arabinosyl	*
8. Petunidin-3-arabinoside	OCH <sub>3</sub>	OH	-O-glucosyl	15.2*
25 9. Peonidin-3-galactoside	OCH <sub>3</sub>	H	-O-galactosyl	1.2
10. Petunidin-3-arabinoside	OCH <sub>3</sub>	OH	-O-arabinosyl	2.9
30 11. Peonidin-3-glucoside	OCH <sub>3</sub>	H	-O-glucosyl	**
12. Malvidin-3-galactoside	OCH <sub>3</sub>	OCH <sub>3</sub>	-O-galactosyl	10.3**
13. Malvidin-3-glucoside	OCH <sub>3</sub>	OCH <sub>3</sub>	-O-glucosyl	14.1
35 14. Peonidin-3-arabinoside	OCH <sub>3</sub>	H	-O-arabinosyl	0.9
15. Malvidin-3-arabinoside	OCH <sub>3</sub>	OCH <sub>3</sub>	-O-arabinosyl	4.0

\* Pigment 7 and 8 together

\*\* Pigment 11 and 12 together

TABLE II

Structures and relative proportions (%) of the individual anthocyanins in the second purified *Vaccinium myrtillus* sample 5 (sample VA-2) with reference to formula I, R<sub>4</sub> is OH, R<sub>5</sub> is H and R<sub>6</sub> is OH

COMPOUND	R <sub>1</sub>	R <sub>2</sub>	R <sub>3</sub>	Proportions (%)
10 1. Delphinidin-3-galactoside	OH	OH	-O-galactosyl	6.4
2. Delphinidin-3-glucoside	OH	OH	-O-glucosyl	7.4
3. Cyanidin-3-galactoside	OH	H	-O-galactosyl	20.2
15 4. Delphinidin-3-arabinoside	OH	OH	-O-arabinosyl	11.0
5. Cyanidin-3-glucoside	OH	H	-O-glucosyl	22.8
20 6. Petunidin-3-galactoside	OCH <sub>3</sub>	OH	-O-galactosyl	1.6
7. Cyanidin-3-arabinoside	OH	H	-O-arabinosyl	*
8. Petunidin-3-arabinoside	OCH <sub>3</sub>	OH	-O-glucosyl	11.4*
25 9. Peonidin-3-galactoside	OCH <sub>3</sub>	H	-O-galactosyl	1.2
10. Petunidin-3-arabinoside	OCH <sub>3</sub>	OH	-O-arabinosyl	**
30 11. Peonidin-3-glucoside	OCH <sub>3</sub>	H	-O-glucosyl	**
12. Malvidin-3-galactoside	OCH <sub>3</sub>	OCH <sub>3</sub>	-O-galactosyl	8.5**
13. Malvidin-3-glucoside	OCH <sub>3</sub>	OCH <sub>3</sub>	-O-glucosyl	7.4
35 14. Peonidin-3-arabinoside	OCH <sub>3</sub>	H	-O-arabinosyl	trace
15. Malvidin-3-arabinoside	OCH <sub>3</sub>	OCH <sub>3</sub>	-O-arabinosyl	2.1

40

\* Pigment 7 and 8 together

\*\* Pigment 10, 11 and 12 together

The compound or mixture of compounds for use according to the invention are claimed to be potent antineoplastic candidates while they at the same time exhibit a very low toxic effect on normal cells and normal cell growth. Thus, the compound or  
5 mixture of compounds for use as antineoplastic compounds may be further defined as an anthocyanidin or an anthocyanidin derivative, which, when dissolved in DMSO at a concentration so that the final concentration of DMSO does not exceed 0.2% v/v DMSO, and tested as described in section 2.3, does not have a  
10 cytotoxic effect on the growth of uninfected SupT1 cells resulting in a decrease in OD<sub>580</sub> of more than 50% such as, e.g., 40%, 30%, 20%, or 10% as a result of incubation with the anthocyanidin or the anthocyanidin derivative, and when tested according to a standard test system for testing potential  
15 anticancer drugs demonstrates an antineoplastic effect. Such a standard test could be, e.g., a systematic protocol established by the National Cancer Institute (NCI) involving the testing of a compound against a standard cell line panel containing 60 human tumor cell lines. The protocol and the established  
20 statistical means for analyzing the results obtained by the standardized testing are well described in the literature, see, e.g., Boyd M. R.: Principles & Practice of Oncology, PPO Updates, Volume 3, No. 10, October 1989 (description of the testing protocol) and Paul, K.D.: "Display and Analysis of  
25 Patterns of Differential Activity of Drugs Against Human Tumor Cell Lines, Development of Mean Graph and COMPARE Algorithm, Journal of the National Cancer Institute Reports, Vol. 81, No. 14, p. 1088, July 14, 1989 (description of the methods of statistical analysis).

In analogy, the compound or mixture of compounds for use as inhibitors of the degradation of connective tissues may be further defined as an anthocyanidin or an anthocyanidin derivative, which, when dissolved in DMSO at a concentration so  
5 that the final concentration of DMSO does not exceed 0.2% v/v DMSO, and tested as described in section 2.3, does not have a cytotoxic effect on the growth of uninfected SupT1 cells resulting in a decrease in OD<sub>580</sub> of more than 50% such as, e.g., 40%, 30%, 20%, or 10% as a result of incubation with the antho-  
10 cyanidin or the anthocyanidin derivative, and when tested on various proteinases, and especially on matrix metalloproteinases (MMPs) exhibit an inhibiting effect.

In analogy, the compound or mixture of compounds for use as  
15 antiviral compounds may be further defined as an anthocyanidin or an anthocyanidin derivative, which, when dissolved in DMSO at a concentration so that the final concentration of DMSO does not exceed 0.2% v/v DMSO, and tested as described in section 2.3, does not have a cytotoxic effect on the growth of  
20 uninfected SupT1 cells resulting in a decrease in OD<sub>580</sub> of more than 50% such as, e.g., 40%, 30%, 20%, or 10% as a result of incubation with the anthocyanidin or the anthocyanidin derivative, and when tested in a standard virus test system shows antiviral effect.

25

It is contemplated that the anthocyanidin or anthocyanidin derivatives and pharmaceutically acceptable salts thereof are effective against viruses selected from the group consisting of: parvovira; papovavira, such as papilloma virus; adenovira;  
30 herpesvira such as Epstein-Barr virus, cytomegalovirus, herpes

simplex vira (HSV 1 and HSV 2), varicella, herpex zoster virus, hepatitis A, hepatitis B; poxvira such as vaccinia, smallpox, molluscum contagiosum, cowpox, and monkey pox virus; hepadnavira; picornavira such as rhinovira and enterovira; 5 reovira such as rotavirus and orbivirus; arbovira such as toga-, flavi-, bunya-, rhabdo-, arena-, and reovira; coronavira; leukaemia, and sarcoma vira; orthomyxovira such as influenza vira; paramyxovira such as mumps virus, measles virus, parainfluenza virus, and RSV; and other unclassified 10 viruses such as lentivira, non-A, non-B hepatitis vira, and viroids.

Furthermore, it is contemplated that the anthocyanidin or anthocyanidin derivatives and pharmaceutically acceptable salts 15 thereof are effective in the treatment or prevention of neoplastic disorders such as neoplastic disorders selected from the group consisting of epithelial neoplasms and non-epithelial and mixed neoplasms. In the table given below is listed relevant neoplasm based on a histogenetic classification.

20

Tabel III

Cell or Tissue	Benign	Malignant
Type		
25 Epithelial neoplasms surface	papilloma	carcinoma soft carcinoma, cirrous carcinioma hard carcinoma, squamous-cell carcinoma, basal-cell carcinoma, ransitional 30 cell carcinoma, capillary carcinoma, apudomas, esidiocytoma, clear-cell carcinoma,choriocarcinoma, 35 and trabecular carcinoma



Cell or Tissue Type	Benign	Malignant
5 glandular	adenoma	adenocarcinoma spheroidal cell carcinoma, cystadenocarcinoma, papillary adenocarcinoma, and mucous or colloid carcinoma
10 Non-epithelial and mixed neoplasms		
Connective tissues		
adipose	lipoma	liposarcoma
fibrous	fibroma	fibrosarcoma
15 cartilage	chondroma	chondrosarcoma
bone	osteoma	osteosarcoma
smooth muscle	leiomyoma	leiomyosarcoma
striped muscle	rhabdomyoma	rhabdomyosarcoma
mesothelia		mesothelioma
20 Neuro-ectodermal		
glial cells		gliomas, astrocytoma, oligodendroglioma, ependymoma and anaplastic variants
25 nerve cells	ganglioneuroma	neuroblastoma medulloblastoma retinoblastoma
melanocytes	pigmented naevus	malignant melanoma
30 meninges	meningioma	malignant meningioma
nerve sheaths	schwannoma	neurofibrosarcoma
	neurofibroma	
Haemopoietic		leukaemias
35 and lymphoreticular		acute leukaemias, monocytic leukaemia, myeloblastic leukaemia (AML), lymphoblastic leukaemia (ALL) and chronic leukaemia, chronic mycoid leukaemia (CML),
40		

Cell or Tissue Type	Benign	Malignant
5		chronic lymphocytic leukaemia (CLL), hairy cell leukaemia other myeloproliferative disorders, myelomatosis, myelofibrosis lymphomas Hodgkin's disease, non-Hodgkin's lymphomas, and histiocytic lymphomas
10		
15	Blood vessels and lymphatic vessels Germinal and embryonal cells	haemangioma glomangioma lymphangioma benign teratoma
20	placenta	hydatidiform mole
		haemangiosarcoma Kaposi's disease lymphangiosarcoma malignant teratoma dysgerminoma (F) serminoma (M) choriocarcinoma

The integrity of connective tissues is determined by the  
 25 balance of resorption and repair of components of their  
 cellular matrix. The activity of proteolytic enzymes is  
 rate-limiting for the degradation and therefore the  
 resorption of the collagen and other macromolecular  
 constituents of the extracellular matrix. Among the  
 30 potential proteinases, the matrix metalloproteinases (MMPs)  
 have a major role in physical resorption of collagen and  
 other macromolecules in development and postnatal  
 remodelling and in pathological resorption associated, for  
 example, with local invasiveness of malignant tumours,  
 35 resorption of the periodontal structures in periodontal  
 disease, and the destruction of joints in rheumatoid

arthritis. The MMP genes are among the most abundant of those expressed by cells in these inflammatory and malignant lesions.

5 Thus, it is anticipated that inhibitors of MMPs, especially MMP-1, inhibit tumor invasion and metastasis, and also control the activity of MMPs and preserve the integrity of the extracellular matrix, allowing the extracellular matrix to maintain its control over neoplastic progression. Further, it  
10 is anticipated that inhibitors of MMP-1 will inhibit the degradation of connective tissues.

Based upon the disclosure of the present invention, a person skilled in the art will be able to test the compounds of  
15 formula I as outlined. Substances which are considered useful may then be tested for cytotoxic effects in other appropriate cell systems such as different fibroblasts (e.g. HeLa) or other uninfected T-cell lines, uninfected T-cell (e.g. cell lines from ATCC), and in primary human lymphocytes from blood donors,  
20 e.g. enriched for CD4+ cells by means of Dynabeads®.

Furthermore, toxicity tests may be performed such as single dose toxicity tests, e.g. LD<sub>50</sub> (i.e. the dosage at which half of the experimental animals die). In addition to the LD<sub>50</sub> value in rodents it is desirable to determine the highest tolerated dose  
25 and/or lowest lethal dose for other species, e.g. dog and rabbit. If the *in vitro* test results are promising and the LD<sub>50</sub> is high, clinical experiments using humans may be approved taking into consideration the specific type of cancer or virus aimed at.

A person skilled in the art would by use of methods described in standard textbooks, guidelines and regulations as well as common general knowledge within the field be able to select the exact dosage regimen to be implemented for any selected compound using merely routine experimentation procedures.

During the process, the person skilled in the art may decide not to continue studying all the initially selected compounds, or it may be decided to synthesize and test new compounds in view of the initial toxicity and biological results obtained.

The cytotoxic and antiviral effects in HIV infected cells have been examined for one anthocyanin sample isolated from blue potatoes (*Solanum tuberosum*) (Sample SP), which contains one clean anthocyanin (called petanin) comprising an aglycone, three monosaccharide moieties and one aromatic acyl group. The cytotoxic effect is also tested for samples VA-1 and VA-2. Samples VA-1 and VA-2 both contain a mixture of anthocyanins. Each anthocyanin in these mixtures are built from only one aglycone and one monosaccharide. Sample VA-2 contains the same, however, a reduced number of anthocyanin compared to Sample VA-1. Sample SP which contains only one, rather complex anthocyanin, shows the best test results.

Further studies may be performed with respect to other types of viruses and various concentrations of the compounds and mixtures of compounds according to the invention in order to titrate the exact concentration at which a cytotoxic effect or an antiviral effect is obtained.

With reference to Formula I, relevant examples of "C<sub>1-6</sub> alkoxy" are methoxy, ethoxy, propoxy, isopropoxy, n-butoxy, isobutoxy, tert.butoxy, pentoxy and hexoxy.

5 In one embodiment of the invention the alkoxy is selected from the group consisting of methoxy, ethoxy, propoxy, isopropoxy, and butoxy, such as R<sub>1</sub>, R<sub>2</sub>, R<sub>3</sub>, and/or R<sub>4</sub> being methoxy. In a presently preferred embodiment of the invention, the antho-  
cyanin or the anthocyanin derivative is derived from an antho-  
10 cyanidin selected from the group consisting of pelargonidin, apigeninidin, and aurantinidin.

In certain embodiments of the invention at least one of R<sub>1</sub> and R<sub>2</sub> is H, whereas in other embodiments at least one of R<sub>1</sub> and R<sub>2</sub>  
15 is OH. In a presently preferred embodiment, the anthocyanin or the anthocyanin derivative is derived from an anthocyanidin selected from the group consisting of cyanidin, delphinidin, luteolinidin, tricetinidin, 6-hydroxy-cyanidin, 6-hydroxy-delphinidin, 5-methyl-cyanidin, and pulchellidin.

20

In still other embodiments, at least one of R<sub>1</sub> and R<sub>2</sub> is alkoxy. It is presently preferred that in this embodiment the antho-  
cyanin or the anthocyanin derivative is derived from an antho-  
cyanidin selected from the group consisting of peonidin,  
25 petunidin, malvidin, rosinidin, europinidin, hirsutidin, and capensinidin.

The glycosyloxy may be selected from the group consisting of mono-, di-, tri-, oligo-, polysaccharides, and derivatives  
30 thereof. In particular, the glycosyloxy may be substituted with

one or more acyl groups, or the glycosyl may comprise at least two glycosyl groups and at least one acyl group arranged so that at least one acyl group is located between two glycosyl groups.

5

In particular, the acyl group may be selected from the group consisting of acyl groups derived from aromatic and aliphatic acyl groups, such as the group consisting of 4-coumaric acid, caffeic acid, ferulic acid, sinapic acid, 4-hydroxybenzoic  
10 acid, gallic acid, acetic acid, oxalic acid, malonic acid, malic acid, maleic acid, and succinic acid.

In one embodiment of the invention, the glycosyl group is a group derived from a monosaccharide selected from the group  
15 consisting of glucose, galactose, rhamnose, arabinose, xylose, and glucuronic acid.

In another embodiment, the glycosyl group is a group derived from a disaccharide selected from the group consisting of 1,2-  
20 glucosylglucoside (sophorose), 1,3-glucosylglucoside (laminariobiose), 1,6-glucosylglucoside (gentiobiose), 1,2-xylosylgalactoside (lathyrose), 1,2-rhamnosylglucoside (neo-hesperidose), 1,6-rhamnosylglucoside (rutinose), 1,2-xylosylglucoside (sambubiose), 1,6-arabinosylglucoside, and 1,6-  
25 rhamnosylgalactoside.

In a third embodiment, the glycosyl group is a group derived from a trisaccharide selected from the group consisting of 1,2-glucosyl-1,6-glucosylglucoside, 1,2-glucosyl-1,6-rhamno-

sylglucoside, 1,2-xylosyl-1,6-glucosylglucoside, and 1,2-xylosyl-1,6-glucosylgalactoside.

As mentioned in the introduction, anthocyanins are water-soluble glycosides and acylglycosides of anthocyanidins, which are polyhydroxyl and polymethoxyl derivatives of 2-phenylbenzopyrylium (flavylium cation). They belong to the phenolic class of flavonoids with the typical A-ring benzoyl and B-ring hydroxycinnamoyl systems. There are almost 300 naturally occurring structures. The structure of the naturally occurring anthocyanins can be classified according to the basis structure of the aglycone of the anthocyanin, i.e. the anthocyanidin. The following classification is normally used:

- 15 i) common basic structures: pelargonidin (Pg), cyanidin (Cy), and delphinidin (Dp)
- ii) common methylated structures: peonidin (Pn), petunidin (Pt), and malvidin (Mv)
- 20 iii) rare 3-desoxy structures: apigeninidin (Ap), 6-hydroxy-Cy-(6OHCy), and 6-Hydroxy-Dp(6OHDp)
- 25 iv) rare methylated structures: 5-methyl-Cy(5MCy), rosinidin (Rs), pulchellidin (Pl), Europinidin (Eu), Hirsutidin (Hs), and Capensinidin (Cp).

The anthocyanidins and anthocyanidin derivatives which are useful according to the present invention are mainly based on one or more of the structures mentioned above. Especially, anthocyanins are considered as potential antineoplastic and/or  
5 antiviral candidates, and also as potential inhibitors of the degradation of the extracellular matrix and connective tissues. The anthocyanins occur as 3-monoglycosides, 3-biosides and 3-triosides as well as 3,5-diglycosides and more rarely 3,7-diglycosides associated with the sugars glucose, galactose,  
10 rhamnose, arabinose and xylose. A specific example of an anthocyanins which is a potential candidate according to the invention is as mentioned above petanin. Further interesting anthocyanins are:



- Pelargonidin 3-arabinoside
- Pelargonidin 3-glucopyranoside
- Pelargonidin 3-galactoside
- Pelargonidin 3-rhamnoside
- 5 Pelargonidin 3-(6''-acetylglucoside)
- Pelargonidin 3-(6''-malonylglucoside)
- Pelargonidin 3-(6''-malyglucoside)
- Pelargonidin 3-(6''-E-caffeoylglucoside)
- Pelargonidin 3-sophoroside
- 10 Pelargonidin 3-neohesperidoside
- Pelargonidin 3,5 diglucoside
- Pelargonidin 3-galactoside-5-glucoside
- Pelargonidin 3-(6''-acetylglucoside)-5-glucoside
- Pelargonidin 3-(6''-succinylglucoside)-5-glucoside
- 15 Pelargonidin 3-caffeoylglucoside-5-glucoside
- Pelargonidin 3-(4-coumaroylglucoside-5-glucoside
- Pelargonidin 3-caffeoylglucoside-5-malonylglucoside
- Pelargonidin 3,5-di-(6-acetylglucoside)
- Pelargonidin 3,5-diglucoside acylated with malonic acid and 4-
- 20 coumaric acid
- Pelargonidin 3-caffeoylglucoside-5-dimalonylglucoside
- Pelargonidin 3-feruloylgalactoside-5-glucoside
- Pelargonidin 3-(4-coumaroylgalactoside)-5-glucoside
- Pelargonidin 3-sophoroside-5-glucoside
- 25 Pelargonidin 3-(6-(E-(glucosyl)caffeoyl)-glucoside)-5-glucoside
- Pelargonidin 3-sophoroside-5-glucoside and its di-caffeoylglucoside
- Pelargonidin 3-sophoroside-5-glucoside and its tri-
- 30 caffeoylglucoside
- Pelargonidin 3-rhamnosylgalactoside-5-glucoside
- Pelargonidin 3-(4-coumaroylrhamnosylgalactoside)-5-glucoside
- Pelargonidin 3-feruloylrhamnosylgalactoside-5-glucoside
- Pelargonidin 3-(2-(glucosyl)-6-(E-caffeoyl)-glucoside)-5-
- 35 glucoside

- Pelargonidin 3-(2-(6-(E-3-(glucosyl)caffeyl)-glucosyl)-glucoside)-5-glucoside
- Pelargonidin 3-(2-(6-(E-3-(glucosyl)caffeyl)-glucosyl)-6-(E-caffeyl)-glucoside)-5-glucoside
- 5 Pelargonidin 3-(2-(6-(E-3-(glucosyl)caffeyl)-glucosyl)-6-(E-4-(6-(E-3-(glucosyl)caffeyl)-glucosyl)caffeyl)-glucoside)-5-glucoside
- Cyanidin 3-arabinoside
- Cyanidin 3-xyloside
- 10 Cyanidin 3-glucoside
- Cyanidin 3-acetylglucoside
- Cyanidin 3-(6''-malonylglucoside)
- Cyanidin 3-(6''-oxalylglucoside)
- Cyanidin 3-malylglucoside
- 15 Cyanidin 3-(2''-galloylglucoside)
- Cyanidin 3-[6''-(4-coumaroyl)glucoside]
- Cyanidin 3-caffeoylglucoside
- Cyanidin 3-(dimalonylglucoside)
- Cyanidin 3-galactoside
- 20 Cyanidin 3-(2''-galloylgalactoside)
- Cyanidin 3-sophoroside
- Cyanidin 3-[(6''-malonylglucosyl)glucoside]
- Cyanidin 3-gentiobioside
- Cyanidin 3-laminaribioside
- 25 Cyanidin 3-malonyllaminaribioside
- Cyanidin 3-glucosyl(4''-sinapoylglucoside)
- Cyanidin 3-sambubioside
- Cyanidin 3-(6''-E-p-coumaroyl-2''-xylosyl-glucoside)
- Cyanidin 3-neohesperidoside
- 30 Cyanidin 3-rutinoside
- Cyanidin 3-(4''-acetylramnosyl)glucoside
- Cyanidin 3-(2''-galloyl-6''-ramnosylglucoside)
- Cyanidin 3-(2''-glucuronylglucoside)
- Cyanidin 3-(4''-malonyl-2''-glucuronylglucoside)
- 35 Cyanidin 3-(6''-malonyl-2''-glucuronylglucoside)
- Cyanidin 3-xylosylgalactoside

- Cyanidin 3-glucosylgalactoside  
 Cyanidin 3-(6-(6-sinapoylglucosyl)-galactoside)  
 Cyanidin 3-rhamnosylgalactoside  
 Cyanidin 3,5-diglucoside  
 5 Cyanidin 3-(6''-acetylglucoside)-5-glucoside  
 Cyanidin 3,5-di-(6''-acetyl-glucoside)  
 Cyanidin 3-[6''-4-coumaroyl)glucoside]-5-glucoside  
 Cyanidin 3-(6''-caffeoylglucoside)-5-glucoside  
 Cyanidin 3-[6''(4-coumaroyl)glucoside]-5-glucoside  
 10 Cyanidin 3-(6''-feruoylglucoside)-5-glucoside  
 Cyanidin 3,3'-diglucoside malonylcaffeyl  
 Cyanidin 3,3'-diglucoside caffeyl  
 Cyanidin 3-[6''-(4-coumaroyl)glucoside]-5-(6'''-malonylglucoside)  
 15 Cyanidin 3-(6''-feruloylglucoside)-5-(6''-malonylglucoside)  
 Cyanidin 3-[6''-(4-coumaroyl)glucoside]-5-(6'''-malonylglucoside)  
 Cyanidin 3-(6''-caffeoylglucoside)-5-(6'''-malonylglucoside)  
 Cyanidin 3-(4-coumaroyl)glucoside-5-dimalonylglucoside  
 20 Cyanidin 3-caffeoylglucoside-5-dimalonylglucoside  
 Cyanidin 3-xylosylglucosylgalactoside  
 Cyanidin 3-[(6''-sinapoylglucosyl)xylosylgalactoside]  
 Cyanidin 3-[(6''-(4-coumaroyl)glucosyl)xylosylgalactoside]  
 Cyanidin 3-[(6''-feruloylglucosyl)-xylosylgalactoside]  
 25 Cyanidin 3-[(6''(4-hydroxy-benzoyl)glucosyl)xylosylgalactoside]  
 Cyanidin 3-sambubioside-5-glucoside  
 Cyanidin 3-(6''-Z-p-coumaroyl-2''-xylosyl)-glucoside)-5-glucoside  
 Cyanidin 3-(6''-E-p-coumaroyl-2''-xylosyl)-glucoside)-5-glucoside  
 30  
 Cyanidin 3-sambubioside-5-glucoside acylated with malonic acid, ferulic acid and sinapic acid  
 Cyanidin 3-(6-p-coumaryl-2-(2-sinapyl-xylosyl)-glucoside)-5-(6-malonylglucoside)  
 35 Cyanidin 3-(6-p-caffeyl-2-(2-sinapyl-xylosyl)-glucoside)-5-(6-malonylglucoside)

- Cyanidin 3-(6-p-ferulyl-2-(2-sinapyl-xylosyl)-glucoside)-5-(6-malonylglucoside)
- Cyanidin 3-(6-p-ferulyl-2-(2-sinapyl-xylosyl)-glucoside)-5-(6-glucoside)
- 5 Cyanidin 3-diglucoside-5-glucoside
- Cyanidin 3-diglucoside-5-glucoside acylated with 4-hydroxybenzoyl
- Cyanidin 3-diglucoside-5-glucoside acylated with caffeic acid
- Cyanidin 3-diglucoside-5-glucoside acylated with caffeic acid
- 10 and 4-hydroxybenzoic acid
- Cyanidin 3-caFFEYLferulysophoroside-5-glucoside
- Cyanidin 3-sophoroside-5-glucoside acylated with 4-hydroxybenzoic acid, 4-coumaric acid, caffeic acid, and ferulic acid
- 15 Cyanidin 3-[6''-(4-coumaroyl)glucosylglucoside]-5-glucoside
- Cyanidin 3-(6''-feruloylglucosylglucoside)-5-glucoside
- Cyanidin 3-(6''-sinapoylglucosylglucoside)-5-glucoside
- Cyanidin 3-[6''-(4-coumaroyl)glucosyl-(2'''-sinapoylglucoside)]-5-glucoside
- 20 Cyanidin 3-[6''-feruloylglucosyl-[2'''-sinapoylglucoside)]-5-glucoside
- Cyanidin 3-[(6''-sinapoylglucosyl-(2'''-sinapoylglucoside)]-5-glucoside
- Cyanidin 3-trisinapoylglucoside-3',7-diglucoside
- 25 Cyanidin 3-sambubioside-5-sophoroside acylated with malonic acid, 4-coumaric acid and sinapic acid
- Cyanidin 3-sambubioside-5-sophoroside acylated with malonic acid ferulic acid and sinapic acid
- Cyanidin (3-feruloyl, 1 x terminal glucose; 3 x feruloyl)
- 30 3,7,3'-triglucoside
- Cyanidin 3-(6-(4-E-p-coumaryl-rhamnosyl)-glucoside)-5-(6-malonyl-glucoside)-3'-(6-E-caFFEYL-glucoside)
- Cyanidin 3-(6-malonyl-glucoside)-7-(6-E-p-coumarylglucoside)-3'-(6-(E-4-(6-(E-p-coumaryl-glucosyl)-p-coumaryl-glucoside)
- 35

- Cyanidin 3-(2-(glucosyl)-6-(trans-4-(glucosyl)caffeyl)-glucosyl)-5-glucoside)  
Cyanidin-3-(6-malonyl-glucoside)-7,3'-di-(6-(4-(glucosyl)oxybenzoyl)-glucoside)
- 5 Delphinidin 3-arabinoside  
Delphinidin 3-glucoside  
Delphinidin 3-acetylglucoside  
Delphinidin 3-(6''-malonylglucoside)  
Delphinidin 3-galactoside
- 10 Delphinidin 3-(2''-galloylgalactoside)  
Delphinidin 3-rutinoside  
Delphinidin 3-neohesperidoside  
Delphinidin 3,5-diglucoside  
Delphinidin 3-(6''-acetylglucoside)-5-(6'''-acetylglucoside)
- 15 Delphinidin 3-(6''-2-p-coumaroylglucoside)-5-(6'''-malonylglucoside)  
Delphinidin 3-galactoside-5-glucoside  
Delphinidin 3-(4-coumaroylgalactoside)-5-glucoside  
Delphinidin 3-rhamnoside-5-glucoside
- 20 Delphinidin 3,5-diglucoside acylated with malonic acid and 4-coumaric acid  
Delphinidin 3,5-diglucoside acylated with malonic acid and caffeic acid  
Delphinidin 3,5-diglucoside acylated with 4-coumaric acid and 2x malonic acid
- 25 Delphinidin 3,5-diglucoside acylated with caffeic acid and 2x caffeic acid  
Delphinidin 3-(2''-xylosyl-6''-rhamnosylglucoside).  
Delphinidin 3,3',5'-triglucoopyranoside
- 30 Delphinidin 3-(6''-rhamnosylglucoside)-7-glucoside  
Delphinidin 3-rhamnosylgalactoside-5-glucoside  
Delphinidin 3-(4-coumaroylrhamnosylgalactoside)-5-glucoside  
Delphinidin 3-rutinoside-7-(6-(4-(6-(4-hydroxybenzoyl)-glucosyl)oxybenzoyl-b-D-glucoside)
- 35 Delphinidin 3-(6-(trans-4-(6-(trans-3-(glucosyl)-caffeyl)-glucosyl)-caffeyl)-glucoside)-5-((6-malonyl)-glucoside)

- Delphinidin 7-(6-(4-(6-(4-hydroxybenzoyl)-glucosyl)-oxybenzoyl)-glucoside-3-(6-rhamnosyl-glucoside)
- Delphinidin 7-(6-(4-(6-(4-(6-p-hydroxybenzoyl-glucosyl)oxybenzoyl)-glucosyl)oxybenzoyl)-glucoside)-3-
- 5 (6-rhamnosylglucoside)
- Delphinidin 7-(6-(4-(6-(4-(glucosyl)oxybenzoyl)-glucosyl)oxybenzoyl)-glucoside)-3-(6-(rhamnosyl)-glucoside)
- (6''-(delphinidin 3-(6''-(glucosyl)-glucosyl))) (6''-(apigenin
- 10 7-(glucosyl))) malonate
- Peonidin 3-arabinoside
- Peonidin 3-glucoside
- Peonidin 3-acetylglucoside
- Peonidin 3-(6''-malonylglucoside)
- 15 Peonidin 3-(4-coumaroyl)glucoside
- Peonidin 3-galactoside
- Peonidin 3-rutinoside
- Peonidin 3-sophoroside
- Peonidin 3-cinnamoylsophoroside
- 20 Peonidin 3-[glucosyl(4''-sinapoylglucoside)]
- Peonidin 3-(2''-xylosylgalactoside)
- Peonidin 3,5-diglucoside
- Peonidin caffeoyl 3,5-diglucoside
- Peonidin 3-sophoroside-5-glucoside
- 25 Peonidin 3-[6''-4-glucosylcaffeoyl)sophoroside]-5-glucoside
- Peonidin 3-sophoroside-5-glucoside and its mono-caffeoylglucoside
- Peonidin 3-sophoroside-5-glucoside 6,6''-trans-dicaffeate
- Peonidin 3-caFFEylferulysophoroside-5-glucoside
- 30 Peonidin 3-sophoroside-5-glucoside and its tri-caffeoylglucoside
- Peonidin 3-sophoroside-5-glucoside acylated with caffeic acid and 4-hydroxybenzoic acid 4-coumaric acid and ferulic acid
- Peonidin 3-sophoroside-5-glucoside 4'-glucosylcaffeate
- 35 Peonidin 3-diglucoside-5-glucoside glucoside acylated with 4-hydroxybenzoic acid

- Peonidin 3-(6-(E-(glucosyl)caffeyl)-glucoside)-5-glucoside  
Peonidin 3-diglucoside-5-glucoside acylated with ferulic acid  
Peonidin 3-diglucoside-5-glucoside acylated with caffeic acid  
and 4-hydroxybenzoic acid  
5 Peonidin 3-diglucoside-5-glucoside acylated with caffeic acid  
ferulic acid  
Peonidin (3 x feruloyl, 1 x caffeoyl)3-diglucoside-5-glucoside  
Peonidin (2 x feruloyl, 1 x caffeoyl)3-diglucoside-5-glucoside  
Peonidin 3-(6-(4-E-p-coumaroyl-rhamnosyl)-glucoside)-5-  
10 glucoside  
Peonidin 3-caffeoylrutinoside-5-glucoside  
Petunidin 3-arabinoside  
Petunidin 3-glucoside  
Petunidin 3-acetylglucoside  
15 Petunidin 3-(6''-malonylglucoside)  
Petunidin 3-(4-coumaroyl)glucoside  
Petunidin 3-galactoside  
Petunidin 3-rutinoside  
Petunidin 3-[6''-(4-coumaroyl)rhamnosyl]glucoside  
20 Petunidin 3,5-diglucoside  
Petunidin 3-O-(6-O-E-p-coumaroylglucoside)-5-O-(6-O-  
malonyl-glucoside)  
Petunidin 3-rhamnoside-5-glucoside  
Petunidin 3-caffeoylrutinoside-5-glucoside  
25 Petunidin 3-O-(6-O-(4-O-E-p-coumaroylrhamnosyl)-glucoside)-5-O-  
glucoside  
Malvidin 3-arabinoside  
Malvidin 3-glucoside  
Malvidin 3-acetylglucoside  
30 Malvidin 3-(6''-malonylglucoside)  
Malvidin 3-(4-coumaroyl)glucoside  
Malvidin 3-caffeoylglucoside  
Malvidin 3-rutinoside  
Malvidin 3,5-diglucoside  
35 Malvidin 3-(6''-malonylglucoside)-5-glucoside  
Malvidin 3-(6''-acetylglucoside)-5-glucoside

- Malvidin 3-galactoside  
Malvidin 3-[6''-(4-coumaroyl)glucoside]-5-glucoside  
Malvidin 3,5-diglucoside acylated with 4-coumaric acid and  
malonic acid  
5 Malvidin 3,5-diglucoside acylated with caffeic acid and  
malonic acid  
Malvidin 3,5-diglucoside acylated with 4-coumaric acid and 2x  
malonic acid  
Malvidin 3,5-diglucoside acylated with caffeic acid and 2x  
10 malonic acid  
Malvidin 3-rhamnoside-5-glucoside  
Malvidin 3-(p-coumarylglucoside)-5-acetylxyloside  
Malvidin 3-sophorose-5-glucoside  
Malvidin 3-(dicaffeoylsophorose)-5-glucoside  
15 Malvidin 3-caffeoylrutinoside-5-glucoside

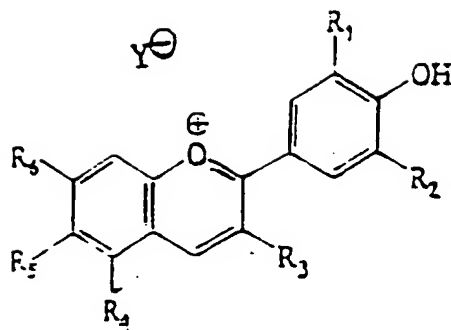
Other interesting anthocyanins are:

- 6-Hydroxypelargonidin (aurantinidin)  
6-Hydroxycyanidin  
20 6-Hydroxydelphinidin  
6-Hydroxycyanidin 3-rutinoside  
6-Hydroxydelphinidin 3-rutinoside  
Alatanin A  
Alatanin B  
25 Alatanin C  
Apigeninidin caffeoyl 5-arabinoside  
Dimalonylwobanin  
Malonylwobanin  
Campanin  
30 Cyanodelphin  
Heavenly blue anthocyanin  
Hyacin  
Lobelinin A  
Lobelinin B  
35 protodelphin  
Monardein  
Monodemalonylmonardein



- Pelargonidin monodemalonylmonardaein  
Nasunin (violanin)  
Riccionidin A  
Riccionidin B  
5 Rubrocampanin  
Salvianin  
Monodemalonyl salvianin  
Bisdemalonylsalvianin  
Salviadelphin  
10 Salviamalvin  
Monodemalonylsalviadelphin  
Bisdemalonylsalviadelphin  
Ternatin A1  
Ternatin A2  
15 Ternatin B1  
Ternatin D1  
Zebrinin

Some of the compounds within the general formula I are known,  
20 see e.g. "The Flavonoids", ed. J. B. Harborne, T.J. Mabry and  
H. Mabry, Chapman & Hall, 1975, "The Flavonoids. Advances in  
Research", ed. J.B. Harborne and T.J. Mabry, Chapman & Hall,  
1982, "The Flavonoids. Advances in Research since 1980", ed.  
J.B. Harborne, Chapman & Hall, 1988, "The Flavonoids. Advances  
25 in Research since 1986", ed. J.B. Harborne, Chapman & Hall,  
1994 and references in Chemical Abstract, Vol. 119 to 123 under  
the General Subject Index entry Anthocyanins. However, the  
invention in a further aspect relates to novel anthocyanin  
derivatives of the general formula I



wherein

5  $R_1$ ,  $R_2$ ,  $R_3$  and  $R_6$  independently of each other are H, OH, alkoxy, an -O-glycosyl group, an -O-glycosyl group which is substituted with one or more acyl groups, or an -O-glycosyl moiety comprising at least two glycosyl groups and at least one acyl group arranged so that at least one acyl group is located between two  
10 glycosyl groups,

$R_4$  is OH, alkoxy, an -O-glycosyl group, an -O-glycosyl group which is substituted with one or one acyl groups, or an -O-glycosyl moiety comprising at least two glycosyl groups and at  
15 least one acyl group arranged so that at least one acyl group is located between two glycosyl groups,

$R_5$  is H, OH, and

20 Y is a counterion,

or a prodrug, a chemical modification or complex thereof with the exception of the compounds mentioned above.

Furthermore, the invention relates to a method for the preparation of a novel anthocyanidin or an anthocyanidin derivative of the general formula I as defined above, the method comprising isolation and purification of the anthocyanidin or an antho-  
5 cyanidin derivative essentially by the method outlined in Example 1. A man skilled in the art will be aware that in isolation and purification of known or novel anthocyanidin and anthocyanidin derivatives, the method described in Example 1 may be amended as appropriate e.g. by use of other extraction  
10 procedures and chromatographic techniques.

Alternatively, the compounds which are to be used according to the invention or novel compounds according to the invention may be synthesized e.g. as described in Iacobucci. G.A. and Sweeny,  
15 J. G. (1983), "The chemistry of anthocyanins, anthocyanidins and related flavylum salts", *Tetrahedron*, 39, pp. 3005-3038 or as described in Elhabiri, M. et al. (1995), "Anthocyanin chemical synthesis: an important access to natural and synthetic pigments", *Polyphénols Actualités*, No. 13, pp. 11-13.  
20 Chemical synthesis of the anthocyanidins and the anthocyanidin derivatives may give appropriate amendments to stabilize the compounds.

In general, anthocyanins from blueberries are rather simple  
25 anthocyanins. Compared to other anthocyanins, in particular those acylated with aromatic acids like petanin (sample SP), they are more unstable and may therefore be less useful for pharmaceutical purposes. Thus, forms of anthocyanins involving

co-pigmentation of anthocyanins and intra- and inter-molecular association states of anthocyanins are within the scope of the present invention.

- 5 Each anthocyanin may exist in a number of equilibrium forms depending on factors like pH, temperature, concentration, presence of copigments and/or metal ions etc. Together with the variation of building blocks of each anthocyanin and the possibility of existing in several association states
- 10 (including association with metal ions such as  $Mg^{2+}$ ,  $Fe^{2+}$ ,  $Fe^{3+}$  and  $Al^{3+}$ , other phenolics such as cinnamic acids and other flavonoids, and polymeric material) this allows quite a number of structural modifications which may influence effects/activity. All equilibrium forms and association states
- 15 are within the scope of the present invention.

As a consequence of asymmetric centres, the compounds of the present invention can occur as mixtures of diastereomers, racemic mixtures and as individual enantiomers. All asymmetric

20 forms, individual isomers and combinations thereof are within the scope of the present invention.

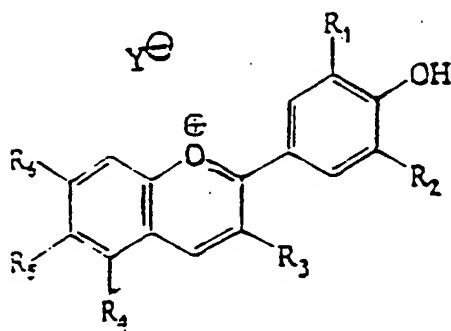
Pharmaceutical compositions comprising mixtures of anthocyanins derived from e.g. blueberries such as Myrtocyan® (Vaccinium

25 myrtillus anthocyanosides corresponding to 25% as anthocyanidines) as well as topical medicinal compositions containing fruit juice or fermented fruit juice as described in CA 1086651, a topical composition consisting of an isopropanol extraction of mountain ash berries as described in US 4,132,782, alcoholic

30 extracts of anthocyanosides described in FR 2456747, composi-

tions comprising bilberry anthocyanidines, grape anthocyanidines or elder anthocyanidines described in GB 1,589,294 and anthocyanidin glycosides extracted from bilberries, black currents and blackberries described in US 3,546,337 are known. However, these compositions are based upon partially purified products from fruit or berries and, in addition to the anthocyanin, do also contain other compounds with a potential pharmaceutical activity such as flavonoids. In contrast, the present invention is based upon much more purified anthocyanins.

A further aspect of the invention thus relates to a pharmaceutical composition comprising an anthocyanidin or anthocyanidin derivative of the general formula I



wherein

$R_1$ ,  $R_2$ ,  $R_3$  and  $R_6$  independently of each other are H, OH, alkoxy, an -O-glycosyl group, an -O-glycosyl group which is substituted with one or more acyl groups, or an -O-glycosyl moiety comprising at least two glycosyl groups and at least one acyl group arranged so that at least one acyl group is located between two glycosyl groups,

R<sub>4</sub> is OH, alkoxy, an -O-glycosyl group, an -O-glycosyl group which is substituted with one or one acyl groups, or an -O-glycosyl moiety comprising at least two glycosyl groups and at least one acyl group arranged so that at least one acyl group  
5 is located between two glycosyl groups,

R<sub>5</sub> is H, OH, and

Y is a counterion,

10

or a prodrug, a chemical modification or complex thereof with the exception of the above mentioned compositions.

A particular preferred embodiment of the invention relates to a  
15 pharmaceutical composition comprising petanin in combination with a pharmaceutically acceptable excipient.

Other preferred embodiments are pharmaceutical compositions comprising a mixture of individual anthocyanins as outlined in  
20 Table I or in Table II in combination with a pharmaceutically acceptable excipient. Also pharmaceutical compositions comprising a novel anthocyanin derivative in combination with a pharmaceutically acceptable excipient are within the concept of the present invention.

25

With respect to the counterion Y, it should be recognized that the particular counterion forming part of the salt of this invention is not of a critical nature, as long as it is compatible with the anthocyanidin or anthocyanidin derivative cation.

The counterion is in particular a pharmacologically acceptable anion. The counterion may be organic as well as inorganic in nature.

5 The term "pharmaceutically acceptable anion" as used herein refers to anions in the salts of the above formula which are substantially non-toxic to living organisms. Typical pharmaceutically acceptable anions include those derived from a mineral or organic acid.

10

Examples of such inorganic acids are hydrochloric acid, hydrobromic acid, hydroiodic acid, sulfuric acid, phosphoric acid and the like, and examples of the organic acids are p-toluenesulphonic acid, methanesulfonic acid, oxalic acid, p-bromo-  
15 phenylsulfonic acid, carbonic acid, succinic acid, citric acid, benzoic acid, acetic acid and the like.

Examples of the anions are sulfate, pyrosulfate, bisulfate, sulfite, bisulfite, phosphate, monohydrogenphosphate, dihydro-  
20 genphosphate, metaphosphate, pyrophosphate, chloride, bromide, iodide, acetate, proprionate, decanoate, caprylate, acrylate, formate, isobutyrate, caproate, heptanoate, propionate, oxalate, malonate, succinate, suberate, sebacate, fumarate, maleate, butyne-1,4-dioate, hexyne-1,6-dioate, benzoate,  
25 chlorobenzoate, methylbenzoate, dinitrobenzoate, hydroxybenzoate, methoxybenzoate, phthalate, sulfonate, xylenesulfonate, phenylacetate, phenylproprionate, phenylbutyrate, citrate, lactate, g-hydroxybutyrate, glycolate, tartrate, methanesulfonate, propanesulfonate, naphthalene-1-  
30 sulfonate, naphthalene-2-sulfonate, and mandelate anions, and

the like. Preferred anions are those derived from mineral acids such as hydrochloric acid and hydrobromic acid, and those formed with organic acids such as maleic acid and methanesulfonic acid.

5

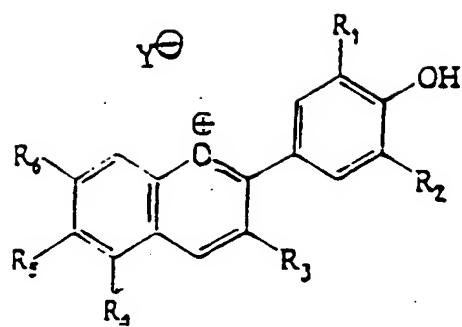
The compositions of the present invention are useful in the prevention or treatment of neoplastic disorders, diseases caused by degradation of connective tissues or a disease caused by a virus.

10

For these purposes, the compounds of the present invention may be administered orally, parenterally (including subcutaneous injections, intravenous, intramuscular, intrasternal injection or infusion techniques), by inhalation spray, or rectally, in  
15 dosage unit formulations containing conventional non-toxic pharmaceutically acceptable carriers, adjuvants and vehicles.

Thus, in accordance with the present invention there is further provided a method for the prevention and/or treatment of  
20 neoplastic disorders, diseases caused by lesions in the connective tissues or a disease caused by a virus, the method comprising administering to a mammal in need thereof an effective amount of an anthocyanin derivative of the general formula I





wherein

$R_1$ ,  $R_2$ ,  $R_3$  and  $R_6$  independently of each other are H, OH, alkoxy, an -O-glycosyl group, an -O-glycosyl group which is substituted with one or more acyl groups, or an -O-glycosyl moiety comprising at least two glycosyl groups and at least one acyl group arranged so that at least one acyl group is located between two glycosyl groups

10  $R_4$  is OH, alkoxy, an -O-glycosyl group, an -O-glycosyl group which is substituted with one or one acyl groups, or an -O-glycosyl moiety comprising at least two glycosyl groups and at least one acyl group arranged so that at least one acyl group is located between two glycosyl groups,

15

$R_5$  is H, OH, and

Y is a counterion,

20 or a prodrug, a chemical modification or complex thereof.

The treatment involves administering to a patient in need of such treatment a pharmaceutical composition comprising a pharmaceutical carrier and a therapeutically effective amount of a

compound of the present invention, or a pharmaceutically acceptable salt thereof.

These pharmaceutical compositions may be in the form of orally  
5 administrable suspensions or tablets; nasal sprays; sterile injectable preparations, for example, as sterile injectable aqueous or oleaginous suspensions or suppositories.

When administered orally as a suspension, these compositions  
10 are prepared according to techniques well-known in the art of pharmaceutical formulation and may contain microcrystalline cellulose for imparting bulk, alginic acid or sodium alginate as a suspending agent, methylcellulose as a viscosity enhancer, and sweeteners/flavouring agents known in the art. As immediate  
15 release tablets, these compositions may contain microcrystalline cellulose, dicalcium phosphate, starch, magnesium stearate and lactose and/or other excipients, binders, extenders, disintegrants, diluents and lubricants known in the art.

20

When administered by nasal aerosol or inhalation, these compositions are prepared according to techniques well-known in the art of pharmaceutical formulation and may be prepared as solutions in saline, employing benzyl alcohol or other suitable  
25 preservatives, absorption promoters to enhance bioavailability, fluorocarbons, and/or other solubilizing or dispersing agents known in the art.

The injectable solutions or suspensions may be formulated according to known art, using suitable non-toxic, parenterally acceptable diluents or solvents, such as mannitol, 1,3-butanediol, water, Ringer's solution or isotonic sodium chloride solution, or suitable dispersing or wetting and suspending agents, such as sterile, bland, fixed oils, including synthetic mono- or diglycerides, and fatty acids, including oleic acid.

When rectally administered in the form of suppositories, these compositions may be prepared by mixing the drug with a suitable non-irritating excipient, such as cocoa butter, synthetic glyceride esters or polyethylene glycols, which are solid at ordinary temperature but liquidify and/or dissolve in the rectal cavity to release the drug.

15

Dosage levels of the order of 0.02 to 5.0 or 10.0 g per day are useful in the treatment or prevention of the above-indicated conditions, with oral doses two to five times higher. For example, infection by a virus is effectively treated by the administration of from 1.0 to 50 mg of the compound per kg of body weight from one to four times per day. In one preferred regimen, dosages of 100-400 mg every six hours are administered orally to each patient. It will be understood, however, that the specific dose level and frequency of dosage for any particular patient may be varied and will depend upon a variety of factors including the activity of the specific compound employed, the metabolic stability and length of action of that compound, the age, body weight, general health, sex, diet, mode

and time of administration, rate of excretion, drug combination, the severity of the particular condition, and the host undergoing therapy.

- 5 The anthocyanidin or anthocyanidin derivatives may be useful either as compounds or mixtures of compounds, pharmaceutically acceptable salts, pharmaceutical composition ingredients, either solely anthocyanidin or anthocyanidin derivatives or in combination with other anti-viral agents, immunomodulators, 10 antibiotics or vaccines. For example, the compounds of this invention may be effectively administered, whether at periods of pre-exposure and/or post-exposure, in combination with effective amounts of other antiviral agents, immunomodulators, anti-infectives, or vaccines known to those of ordinary skill 15 in the art.

In the following Examples, HIV virus has been used in order to demonstrate an effect against retroviruses. It is, however, contemplated that HIV virus can be replaced by other types of 20 non-retroviruses in order to obtain further results.

Experiments in progress to further characterize general biological effects, antineoplastic and antiviral properties, and the connective tissues repairing effect of anthocyanidins or anthocyanidin derivatives

5

To further study the effect of anthocyanidins in relation to the potentials of these compounds and to get a mechanistic understanding of how these compounds exert their effect a number of different experiments have been initiated or  
10 designed.

The experiments can be divided into groups according to the goals of the studies:

15 I. Cytotoxic effects

- i) In tissue culture studies
- ii) In vivo studies in mice

II. In vitro studies with defined cell lines

20

III. Studies on various enzyme systems

IV. Antiviral effects of the compounds measured in tissue culture studies

25

Studies in group I i) includes characterization of effects of the compounds on cell growth of a number of different established cell lines like the CD4+ human cell lines with lymphocytic phenotypes (Jurkat, CME, H-9, Molt-3, all from ATCC), the  
30 monocytic cell line U937 (also from ATCC), and a CD4+ HeLa

(fibroblast) cell line. Peripheral human lymphocytes are also included in these studies. These cells are isolated from normal healthy blood donors, isolated by standard Lymphoprep methods (Nycodens), incubated with the test compounds, stimulated with  
5 phytohemagglutinin or cytokines and tested for their ability to incorporate radioactive thymidine.

The aim of these studies is to determine what doses of the test compounds human cells can tolerate without affecting the growth  
10 potential of these cells. Furthermore, these studies will be expanded to include long term effects on the cells of low concentrations of the test compounds. At doses where growth is affected, the aim is to study the mechanisms of growth inhibition. To get a general idea of how these compounds interact  
15 with cells at toxic or semitoxic doses, the cells are first characterized after treatment with test compounds using electron microscopy. Based on the results of those studies, different biochemical studies will be designed to further elucidate the mechanism behind the cytotoxic effects.

20

Using these tissue culture systems, pharmacokinetic properties of the compounds will be studied, the goal being to evaluate the efficiency of uptake as well as the stability of the compounds in human cells.

25

The main goal of the group I ii) studies is to determine LD<sub>50</sub> in mice. As part of these studies, it is also desired to evaluate the clearance of the different compounds by analyzing urine samples from the treated animals.

30

The group II studies include a number of standard tests designed to demonstrate whether the test compounds have an antineoplastic effect.

- 5 The studies in group III are based on the fact that proteases are digestive enzymes which normally are present in all types of cells within the body (Protein Degradation in Health and Disease, (1980) Ciba Foundation Symposium 75, Excerpta Medica, Amsterdam). During the last years, research within the field of
- 10 cancer has revealed that neoplastic cell may contain an increased concentration of some proteases compared with the concentration in normal cells (Proteinases and Tumor Invasion, (1980) Monograph Series of the European Organization for Research on Treatment of Cancer, Vol. 6 (Sträuli, P., Barrett,
- 15 A.J. & Baici, A., eds.), Raven Press, New York). Furthermore, it has been found that neoplastic cells are able to excrete proteases influencing and degrading surrounding cells and tissues (Parish, D.C. (1994) The role of proteolysis in tumour invasion and growth. Endocrine-Related Cancer 1: 19-36). In
- 20 this way the neoplastic cells get more ready access to growth, propagation and metastases. A relationship between enzymatic activity and metastasis has been found (Liotta, L.A., Tryggvason, K., Garbisa, S., Hart, I., Foltz, C.M. & Shafie, S. (1980). Metastatic potential correlates with enzymatic
- 25 degradation of basement membrane collagen. Nature 284: 67-68; Sloane B.F., Dunn. J.R. & Honn, K.Y. (1981) Lysosomal cathepsin B: correlation with metastatic potential. Science 212: 1151-1153).

An enhanced protease activity has been observed in experimental studies of brain tumours (Aardal, N-P., Bjerkvig, R., McDonald, J.K. & Andersen, K-J. (1989) Increased lysosomal exopeptidase activity in brain tumor transition zone. Pathol. Res. Pract. 5 185:6) and in various types of tumours in thyroidea (Akslen, L.A., Aas, T., Varhaug, J.E. & Andersen, K-J. (1994) Increase of Endo- and Exo-peptidases in Thyroid Tumours. Oncology Reports, 1: 953-956) and in the digestive tract (Aardal, N-P., Solsvik, J. & Andersen, K-J. (1994) The Proteolytic Activity in 10 Normal Mucosa and in Adenocarcinomas of the Colon and Rectum. A Study on 49 Patients. XX International Congress of the International Academy of Pathology, Hong Kong.; Andersen, K-J. & Aardal, N.P. (1996) Acid Hydrolase Activity in Human Colon and Rectum Cancer. In preparation).

15

Furthermore, it is known that the activity of a number of proteases normally is controlled by specific inhibitors. This may prove to be an important issue in the future treatment of cancer.

20

The studies in group III are designed to test the effect of anthocyanins on proteases including endo- and exopeptidases. The degree of inhibition of activity is measured in human tissue extracts from normal tissue as well as from various 25 types of tumor tissues. Furthermore, the degree of inhibition of activity is measured in cell extracts from cell cultures of established cell lines and primary cell cultures. In principle the tests can be performed on all proteases; however, the following proteases have been selected for the present purpose:

30



Aminopeptidases:	Leucine aminopeptidase
	Aminopeptidase M
	Aminopeptidase P
5 Dipeptidyl peptidases:	Dipeptidyl peptidase I (Cathepsin C)
	Dipeptidyl peptidase II
	Dipeptidyl peptidase IV
10 Tripeptidyl peptidases:	Tripeptidyl peptidase I (pH 4.5)
	Tripeptidyl peptidase II (pH 7.0)
Endopeptidases:	Cathepsin B
	Cathepsin L
	Cathepsin H
15	Tryptase
	Trypsin

The assays are based on fluorescence assay (see e.g. Andersen, K-J. & Ofstad, J. (1986) Adv. Exp. Med. Biol. 198A: 355-359; Andersen, K-J. & Dobrota, M. (1986) Renal Physiol. 9: 275-383; Andersen, K-J., Haga, H.J. & Dobrota, M (1987) Kidney Int. 31: 886-897; Andersen, K-J. & McDonald, J.K. (1987) Am.J.Physiol., 252 (Renal Fluid Electrolyte Physiol. 21): F 890-F 898; Andersen, K-J. & McDonald, J.K. (1987) Am. J. Physiol. 253 (Renal Fluid Electrolyte Physiol. 22): F649-F65513-18).

A detailed description of the assays for Cathepsin B, Dipeptidyl peptidase I and Dipeptidyl peptidase II is given in the experimental section.

Effect on cells: The increase in number of cells as a function of time is measured and the usual growth curves are obtained indicating the effect on the ability of the cells to growth and propagation. Assays involving Tryptan blue (the coloured cells  
5 indicate dead cells while the uncoloured cells indicate living cells) and Neutral Red Vital Stain are employed (Neutral Red Vital Stain is a convenient chemosensitivity assay for drug screening which is commercially available).

- 10 Morphological changes of cells and tissue: The morphological changes are observed and described by means of standard methods for electron microscopy.

Tissue: The enzymatic activity of the above-mentioned enzymes  
15 is measured in tumour tissue from patients in order to measure total activity of the individual proteases as well as the inhibitory effect.

Cells from cell cultures:

20

Primary culture: Cultivation of human tumor tissue from kidney and intestine under standard conditions.

Permanent tumor cell lines: BT4CN and BT4C are employed (both  
25 cell lines are glioma cells (brain tumor) from a rat. C6 may also be employed (also glioma cells but a number of normal characteristics from glia cells are retained)

Normal cell lines: LLC-PK1 - kidney cells from proximal tubuli of pigs. MDCK- kidney cells from distal tubuli/connecting tubuli of a dog.

5 IV Based on the results from the group I i) studies, the effect of the test compounds at doses not affecting cell growth on syncytia formation and virus production will be studied in the same cell lines. The aim is to find if there are cell line specificities with respect to the antiviral activities of the  
10 compounds studied.

At doses giving an inhibition of viral production, the group IV studies will be conducted. These experiments involve extraction of viral components from infected cells after treatment with  
15 the test compounds. The analysis of the extracts include different types of PCR analysis of viral nucleic acids (RNA and DNA) to determine at what stage of the replication cycle inhibition occurs. These studies will be complemented with analysis of viral proteins in the extracts. For the protein  
20 analysis, the viral proteins will be metabolically labelled during infection and treatment, precipitated with specific antisera and/or antibodies, and analyzed by SDS-PAGE and autoradiography.

## 25 LEGEND TO FIGURES

Figure 1 shows the relationship between cell number and staining by MTT.

Figure 2 shows the effect of DMSO on cell growth and that 0.33% DMSO can be used as a solvent for the compounds without affecting cell growth.

5 Figure 3 shows the effect of petanin in different concentrations dissolved in DMSO on the growth of SupT1 cells measured after five days of incubation.

Figure 4 shows the effect of the first purified *Vaccinium myr-*  
10 *tillus* sample (Sample VA-1) in different concentrations dissolved in DMSO on the growth of SupT1 cells measured after 48 hours of incubation.

Figure 5 shows the effect of the second purified *Vaccinium*  
15 *myrtillus* sample (Sample VA-2) in different concentrations dissolved in DMSO on the growth of SupT1 cells measured after five days of incubation.

Figure 6 shows the effect of petanin (sample SP) in different  
20 concentrations on the inhibition of formation of syncytia. The effect is shown as a percentage of the formation of syncytia in cells incubated with only DMSO.

Figure 7 shows the high performance liquid chromatography pro-  
25 files of the anthocyanin content of *Solanum tuberosum* L during the purification procedure. A, crude extract; B, after partition against ethyl acetate and treatment with Amberlite XAD-7; C, after droplet-current chromatography; D, after Sephadex LH-

20 gel filtration. The different samples are monitored simultaneously at two different spectral areas (i and ii). The chromatogram labelled B is recorded for the sample SB.

5 Figure 8 shows the structure of petanin, which is the anthocyanin isolated from *Solanum tuberosum*.

Figure 9 shows the anthocyanin content of the first purified *Vaccinium myrtillus* sample (Sample VA-1) detected at  $520 \pm$   
10 20 nm. The peaks are labelled according to the numbers given in Figure 10.

Figure 10 shows a) the structures and b) the relative proportions (%) of the individual anthocyanins in the first purified  
15 *Vaccinium myrtillus* sample (Sample VA-1).

Figure 11 shows the anthocyanin content of the second purified *Vaccinium myrtillus* sample (Sample VA-2) detected at  $520 \pm$   
20 nm. The peaks are labelled according to the numbers given in Figure 12.

Figure 12 shows a) the structures and b) the relative proportions (%) of the individual anthocyanins in the second purified *Vaccinium myrtillus* sample (Sample VA-2).

25

Figure 13 shows inhibition of MMP-1 in extracts from normal and tumor tissues of human.

Figure 14 shows gelatinolytic activity in normal and tumor  
30 tissues of rectum of human.

Figure 15 shows gelatinolytic activity in normal and tumor tissues of colon of human.

5 Figure 16 shows gelatinolytic activity in normal and tumor tissues of ventricle of human.

Figure 17 shows gelatinolytic activity in normal and tumor tissues of pancreas of human.

10

Figure 18 shows gelatinolytic activity in tumor extracts from rectum preincubated with EDTA (ethylenediaminetetraacetic acid) or EGTA (Ethylene glycol bis( $\beta$ -aminoethyl ether)-N,N,N',N'-tetraacetate).

15

Figure 19 shows gelatinolytic activity in Tumor extracts from pancreas preincubated with EDTA or EGTA.

Figure 20 shows the effect of various anthocyanidin samples on  
20 BT4C and BT4Cn cells.

Figure 21 shows natural red uptake in BT4C cells.

Figure 22 shows natural red uptake in BT4Cn cells.

25

Figure 23 shows the effect of sample SB on cell number of LLCPK1 and BT4Cn cells exposed to sample SB for 24 hours.

Figure 24 shows prosent of dead LLCPK1 and BT4Cn cells upon  
30 exposure to sample SB in 24 hours.

**EXAMPLES****TEST METHODS**

5 Determination of cytotoxic and antiviral effects in HIV  
infected cells of compounds or mixtures of compounds according  
to the invention

1. Cultivation of cells

10

The human CD4+ lymphocyte cell line Sup T1 derived from a Non-Hodgkin's T-cell lymphoma patient (Smith et al. (1984), Cancer Research 44, 5657) was a gift from Dr. J. Sodroski at the Division of Human Retroviruses, Dana Farber Cancer Institute, Harvard Medical School, Boston, U.S.A., and was chosen for these studies due to its high content of CD4+ receptors and ability to form large syncytia following infection with HIV-1. The cells were cultivated as suspension cultures in plastic flasks (NUNC, Copenhagen, Denmark - T25 flasks or T125 flasks) in RPMI 20 1640 medium (Bio Whittaker, Walkersville, MD, USA) supplemented with 5% v/v fetal calf serum, 2 mM glutamine (both from Bio Whittaker) and ABAM (Cat.No. A 9909, Sigma Chem. Company, an 0.1M antibiotic and antimycotic solution containing penicillin and fungizone) in 1 mM final concentration and gentamicine (Bio 25 Whittaker) to a final concentration of 50 mg/ml at 37°C and 5% CO<sub>2</sub> in an incubator (Assab Kebo BioMed).

Counting of cell numbers was performed the same day the experiments started using the Trypan blue exclusion method (Tissue Culture Chemicals, a catalogue from Sigma, 1994) and a Burker counting chamber ("ASSISTENT", Germany) at a magnification of 400x. The ratio between the living and dead cells was at least 95/5 in all experiments determined as described in John Paul, "Cell & Tissue Culture", p. 368, Fifth Edition, Churchill Livingstone, 1975). Prior to the experiments the medium was half-changed in order to add new growth components.

10 The cell density was adjusted to approximately  $5 \times 10^5$  cells/ml and kept at this concentration throughout the experiment by counting the cell number and adding new medium as appropriate or, if necessary, by centrifugation of the cell suspension and resuspension of the cell pellet in an appropriate amount of

15 RPMI 1640 medium.

#### HIV virus producing Molt 3 IIIB cell line

The cell line was established by infecting Molt 3 cells (American Type Culture Collection, ATCC CRL 1552) with the HIV-1 strain HTLV IIIB obtained from Dr. W. A. Haseltine at the Division of Human Retroviruses, Dana Farber Cancer Institute, Harvard Medical School, Boston, U.S.A. The Molt 3 IIIB cell line is producing virus particles constitutively.

25

The cells were cultivated as suspension cultures in plastic flasks (NUNC, Copenhagen, Denmark - T25 flasks or T125 flasks) in RPMI 1640 medium (Bio Whittaker, Walkersville, MD, USA) supplemented with 5% v/v fetal calf serum, 2 mM glutamine (both

30 from Bio Whittaker) and ABAM (Cat.No. A 9909, Sigma Chem. Com-



pany, an 0.1M antibiotic and antimycotic solution containing penicillin and fungizone) in 1 mM final concentration and gentamicine (Bio Whittaker) to a final concentration of 50 mg/ml at 37°C and 5% CO<sub>2</sub> in an incubator (Assab Kebo BioMed).

5

## 2. Cytotoxicity of the compounds or mixture of compounds tested

### 2.1. The MTT assay method for determining the number of viable 10 cells

The principle of this assay is based on the cleavage of the yellow tetrazolium salt MTT (3-(4,5-dimethylthiazol-2-yl)-2,5-diphenyltetrazolium bromide (Thiazolyl blue, Product No. 15 M 5655, Sigma Chemical Company) to form formazan crystal due to the dehydrogenase activity in the living cells (Mosman, T. et al. J. Immunol. Methods, 65, 55). A standard curve for the MTT assay was established (Fig. 1) by diluting exponentially growing SupT1 cells at known cell numbers in a standard medium 20 (RPMI 1640) into a 96 wells tissue plate (NUNC) at a total volume of 100 µl followed by adding 50 µl of MTT reagent (3 mg/ml in phosphate buffer solution (PBS), pH 7.20) to each well. After addition of the MTT reagent, the plate was incubated at 37°C and 5% CO<sub>2</sub> for 3 hours in an incubator (Assab 25 Kebo BioMed). Then the cells were centrifuged at 2,000 rpm (800 x g) for 10 minutes in a centrifuge equipped with micro-titer plate holders (Beckman centrifuge, GS-6). After centrifugation 100 µl of supernatant was removed from the wells. For this purpose a multichannel micro-pipette was used (Finnpipettes, 30 Finland). The pelleted cells were resuspended in 100 µl DMSO

(dimethyl sulfoxide, Merck) and the plates were gently shaken by hand for about 10 minutes at room temperature before the absorption was read in an ELISA reader (Titerek® Multiskan Plus MK II photometer equipped with a 580 nm light filter (Flow Laboratories, USA). The standard curve of the relationship between cell number and staining by MTT is shown in Figure 1 with a ranging from  $10^3$  cells/well to  $5 \times 10^4$  cells/well corresponding to  $OD_{580} = 0.01$  and  $OD_{580} = 0.50$ , respectively. As shown in Figure 1, within the amount of cells used, there is a linear relationship between the number of living cells and the intensity of staining between cell numbers of 20.000 and 60.000. A new standard curve is established as appropriate e.g. when a new series of experiments are started by a hitherto unexperienced person. The reproducibility of the standard curve is good.

## 2.2. Determination of the effect of DMSO on cell growth

Since the water solubility of the compounds to be tested varies, the compound or mixture of compounds to be tested are dissolved in DMSO prior to addition to the cell cultures. The effect of DMSO on the cell growth was therefore tested. The cells were added to a 96 wells micro-titer plate; each well containing  $1 \times 10^4$  cells in 100 ml of RPMI 1640 medium. To the suspension of cells was then added DMSO at different concentrations ranging from 0.01% v/v DMSO to 1.0% v/v DMSO. Following incubation in an incubator (Assab Kebo BioMed) at  $37^\circ\text{C}$  with 5%  $\text{CO}_2$ , the amount of living cells as a function of the DMSO concentration was evaluated after 1, 2, and 5 days of incubation by applying the MTT assay as described above. From

the results of the experiments (Figure 2) it can be deducted that the maximum concentration of DMSO that could be used without affecting cell growth was 0.2% v/v. Above that concentration DMSO has a significant effect on the growth of 5 SupT1 cells. At 0.2% v/v concentration or lower of DMSO, practically no difference between cells with or without DMSO could be observed. For this reason compounds to be tested in SupT1 cultures in the presence of DMSO have to be kept in solutions at concentrations so that the final concentration of 10 DMSO does not exceed 0.2% v/v DMSO.

### 2.3. Effect of test substances on the growth of uninfected SupT1 cells

15 For each substance to be tested or for each mixture of substances to be tested, 3 parallel experiments were done. Survival of cells were tested after 1, 2, 5, and 7 days, respectively, after starting treatment of the cells with the substances. The cells were maintained in a 96 wells micro-titer plate. To each 20 well  $1 \times 10^4$  cells in 100 ml RPMI 1640 medium were added. To the suspension of cells was then added 10 ml of the test substance in DMSO and RPMI 1640 medium in order to ensure that the final concentration of DMSO did not exceed 0.2% v/v. As control, cells with or without DMSO were used. At the end of incubation 25 at 37°C and 5% CO<sub>2</sub> for 3 hours in an incubator (Assab Kebo BioMed)) with the compounds, survival of the cells was measured by adding the MTT reagent and the samples were processed as described above in section 2.2.

The results of the 3 extracts containing 3 different compounds or mixture of compounds dissolved in DMSO after two to five days of incubation are shown in Figures 3-5.

5 3. Testing compounds or mixture of compounds for antiviral effects

The screening of antiviral effect of different compounds or mixtures of compounds was based on measuring the formation of  
10 syncytia as the exact number of syncytia present after infection of cells with HIV-1 can easily be counted by use of an inverse microscope and thereby an effect obtained by the compound or mixture of compounds added can be measured.

15 HIV-1 containing supernatant from Molt 3 IIIB cell supernatant was prepared by centrifugation of the Molt 3 IIIB cell culture at 1,000 rpm in a Beckmann GS-6 centrifuge equipped with a GH-3.7 rotor for 5 minutes. In order to standardize the supernatant with respect to the amount of virus, p24 Ag was  
20 measured using an ELISA based technique (Sundqvist et al. (1989), J. Medical Virology 29:170-175).

Each virus supernatant used in the experiment had a p24 Ag concentration of  $1.5 - 2 \text{ ng}/10^5$  cells. Each T25 (NUNC) flask was  
25 filled with  $1 \times 10^4$  cells/ml in a total volume of 5 ml. The test substances was added 30 minutes prior to the addition of the virus containing supernatant and during this preincubation the flasks were kept at  $37^\circ\text{C}$  and 5%  $\text{CO}_2$  in an incubator (Assab Kebo BioMed). After preincubation, 500 ml of virus supernatant was  
30 added. The number of syncytia was counted after 24 and 48 hours

of incubation at 37°C and 5% CO in an incubator (Assab Kebo BioMed) (this time was found to be the standard times for optimal syncytia formation for this cell line at the concentration of virus used).

5

For each test substance 2 flasks were used and the syncytia were counted by counting the number of syncytia at 5 different places on each flask in an inverse microscope (Olympus CK 2) using a magnification of 10<sup>x</sup>, thus giving 10 independent 10 countings for each test substance. The parallels obtained were within +- 10% for each experiment.

The results of petanin (sample SP) are shown in Figure 6. The inhibition of formation of syncytia is shown as a percentage of 15 the formation of syncytia in untreated cells.

#### 4. Determination of antineoplastic effect

##### Cells tested:

20 The continuous cancer cell lines BT4C and BT4Cn, both obtained from fetal rat brain cells following in vitro transformation after in vivo exposure to N-ethyl-N-nitrosurea (Laerum, O.D., Rajewsky, M.F., Schachner, M., Stavrou, D., Haglid, K.G., & Haugen, Å. (1977) Phenotypic 25 properties of neoplastic cell lines developed from fetal rat brain cells in culture after exposure to ethylnitrosurea in vivo. Z. Krebsforsch. 89: 273-295.), have been studied.

Cell culture:

Cell cultures were routinely maintained at 37°C at 100% relative humidity in an atmosphere of air containing 5% CO<sub>2</sub> in a serum-supplemented medium consisting of Eagle-  
5 Dulbecco's Modified Medium with 10% new-born calf serum (Gibco, Grand Island, N.Y.) and four times the prescribed concentration of nonessential amino acids, 2% L-glutamine, penicillin (100 IU/mL), and streptomycin (100 mg/mL).  
Routinely a total of 10<sup>5</sup> cells were seeded into 25 cm<sup>2</sup>  
10 tissue culture flasks (Nunc, Denmark) and confluency was reached after 3-4 days.

1. Cell counting and viability assay:

To obtain the total cell count, cells were trypsinized and  
15 collected by centrifugation. Cells were counted electronically using a Coulter counter (Coulter Electronics, Miami, FL). Cell viability was examined using the standard trypan blue dye exclusion test (Freshny, R.I. (1987) culture of animal cells. A manual of basic  
20 techniques. Second dition, pp. 245-256. Alan R. Liss, inc. New York).

2. Cytotoxicity assay:

25 The neutral red vital stain assay for chemosensitivity was used. The assay is based on neutral red as a vital stain accumulates in the lysosomal compartment of the cells following uptake via non-ionic diffusion (Nemes, Z., Dietz, R., Luth, J.B., gomba, S., Hackenthal, F. & Gross, F.  
30 (1979) The pharmacological relevance of vital staining with

neutral red. *Experientia* 35: 1475-1476.; Allison, A.C. & Young, M.R. (1969) Vital staining in fluorescence microscopy of lysosomes. In Dingle, J.T. & Fell, H.B. (eds), *Lysosomes in Biology and Pathology*, Vol. 2, 600-626.

5 Nemes, Z. et al., 1979 and Allison, A.C. et al., 1969).

The assay protocol was: BT4Cn and BT4C cells were seeded in 24-well (16-mm diameter) multidishes from Costar (Cambridge, MA) at a density of  $10^4$  cells per well and grown in the presence of serum-supplemented medium at 37°C and 5%  
10 CO<sub>2</sub> for 24 hours. Then the medium was changed to a chemically defined medium where 5 mg/ml insulin, 20 nM hydro-cortisone, 0.3 nM triiodo-thyronine, 1 mg/ml transferrin, 1.36 mg/ml vitamin B12, 0.007 mg/ml Biotin, 10 mg/ml DL-a-tocopherol, 5 mg/ml retinol, 0.2 mg/ml lipoic  
15 acid, and 0.1 mg/ml linoleic acid were used as a substitute for serum (Akslen, L.A., Andersen, K-J. & Bjerkvik, R., (1988) Characteristics of human and rat glioma cells grown in a defined medium. *Anticancer Research* 797-804) for 24 hours, before cells were exposed to SA or SB over night at  
20 37°C and 5% CO<sub>2</sub>. The cell medium was then decanted and the cells were exposed to 100 ml/well of 0.1% neutral red solution in PBS w/o calcium and magnesium (Gibco) for 3 hours at 37°C. Cells were rinsed with buffer saline and allowed to dry. The dye was eluted with 100 ml of a  
25 solution containing 50% ethanol and 1% glacial acetic acid and the absorbance for each well was determined at 540 nm. Background was determined using the same procedure without exposing cells to the neutral red solution.

Assays

## CATHEPSIN B

- 5 Substrate: 10 mM N-a-CBZ-L-Arginyl-L-Arginine-b-  
naphtylamine 3 AcOH (Mw: 787,9) (glass 300)  
0,029 g/5ml N'-N- dimethylformamide
- Buffer: 50 mM Phosphate buffer, pH=6,5 with 10mM EDTA  
10 10mM dithiothreitol and 0.1% Triton-X-100:  
4,45 g  $\text{Na}_2\text{HPO}_4 \cdot 2\text{H}_2\text{O}$   
0.1% Triton-X-100  
1,86 g EDTA-Titriplex-Na diluted to 500ml with  
 $\text{H}_2\text{O}$   
15 0,771 g dithiothreitol
- Quenching reagent: 50 mM Glycin buffer pH=10.4 37.6 g  
glycin/L



With tissue blank		Without tissue blank
Working solution		Working solution
Substrate diluted 1:2 with buffer		Substrate diluted 1:2 with buffer
Assay		Assay
Sample	Tissue blank	Sample
100 ml sample 200 ml buffer Preincubate 5 min 50 ml working solution	100 ml sample 200 ml buffer Preincubate 5 min 50 ml working solution Incubate 15 min	100 ml sample 200 ml buffer Preincubate 5 min 50 ml working solution Incubate 45 min
Incubate 15 min		
2 ml quenching reagent	2 ml quenching reagent	2 ml quenching reagent

Standard: 10 mM b-naphtylamine (Mw 143.2) (Sigma - N7750)  
14.3 mg/10 ml dried methoxyethanol

5

Calculations are performed based on standard curves (excitation wavelength 340 nm, emission wavelength 410 nm)

## DDP I (Dipeptidylpeptidase)

Substrate: 10 mM H-Gly-arg-bNa (Mw 392.9) (Glass 101)  
0.020 g/5 ml N'N-dimethylformamide

5

Buffer: 10 mM cacodylate buffer, pH=6,0 (uses cacodylic  
acid or Na cacodylate) with 10 mM  
mercaptoethylamine mw=113.6  
Mercaptoethylamine is added immediately before use

10

Quenching reagent: 50 mM Glycin buffer pH=10.4 37.6 g  
glycin/L

With tissue blank		Without tissue blank
Working solution		Working solution
Substrate diluted 1:2 with buffer		Substrate diluted 1:2 with buffer
Assay		Assay
Sample	Tissue blank	Sample
100 ml sample 200 ml buffer Preincubated 5 min 50 ml working solution Incubate 30 min	100 ml sample 200 ml buffer Preincubated 5 min  Incubate 30 min	100 ml sample 200 ml buffer Preincubated 5 min 50 ml working solution
		Incubate 30 min
2 ml quenching reagent	2 ml quenching reagent 50 ml working solution	2 ml quenching reagent

Standard: 10 mM b-naphtylamine (Mw 143.2) (Sigma - N7750)  
14.3 mg/10 ml dried methoxyethanol

Calculations are performed based on standard curves (excitation wavelength 340 nm, emission wavelength 410 nm)

DDP II (Dipeptidylpeptidase)

5 Substrate: 15 mM H-lys-ala-bNa, mw = 342,5, 0.026 g/5ml  
solved in N.N. dimethylformamide

Buffer: 0.1 phosphate buffer pH = 5.0 with 0.1% Triton-  
X-100:

10 1.67 ml orto-phosphoric acid/250 ml + Triton-X-  
100

Quenching reagent: 50 mM Glycin buffer pH=10.4

37.6 g glycin/L pH adjusted with NaOH

With tissue blank		Without tissue blank
Working solution		Working solution
Substrate diluted 1:2 with buffer		Substrate diluted 1:2 with buffer
Assay		Assay
Sample	Tissue blank	Sample
100 ml sample 200 ml buffer 50 ml working solution	100 ml sample 200 ml buffer	100 ml sample 200 ml buffer 50 ml working solution
Incubate 30 min	Incubate 30 min	Incubate 30 min
2 ml quenching reagent	2 ml quenching reagent 50 ml working solution	2 ml quenching reagent

Standard: 10 mM b-naphtylamine (Sigma - N7750)

5 Calculations are performed based on standard curves (excitation wavelength 340 nm, emission wavelength 410 nm)

Matrix Metalloproteinase-1 (MMP-1)

in extracts from tumour and normal tissues from cancer patients.

- 5 MMP-1 was determined by the Biotrak™ ELISA assay system (code RPN 2610) provided by Amersham International, UK.

COMPONENTS OF THE ASSAY SYSTEM

10 Microtitre plate

The plate contains 12 x 8 well strips coated with mouse anti-MMP-1. Ready for use.

Assay buffer 1

- 15 Bottle contains 10 ml of phosphate buffer concentrate which when diluted gives a 0.1 M phosphate buffer pH 7.5 containing 0.9% (w/v) sodium chloride and 0.1% (w/v) bovine serum albumin and 0.1% Tween™ 20. This reagent is for dilution of donkey anti-rabbit peroxidase conjugate only.

20

Assay buffer 2

- Bottle contains 10 ml of phosphate buffer concentrate which when diluted gives a 0.1M phosphate buffer pH 7.5 containing 0.9%(w/v) sodium chloride and 0.1%(w/v) bovine  
25 serum albumin. This reagent is for dilution of standard, antiserum and samples.

Standard

- Vial contains 1 ml human MMP-1 frozen in assay buffer 2 at  
30 a concentration of 200 ng/ml. Ready for use after thawing.

Antibody

Bottle contains lyophilised rabbit anti-MMP-1 which on reconstitution gives rabbit anti-MMP-1 in 0.1 M phosphate buffer pH 7.5 containing 0.9% (w/v) sodium chloride and 5 0.1% (w/v) bovine serum albumin.

Peroxidase conjugate

Bottle contains lyophilised donkey anti-rabbit horseradish peroxidase which on reconstitution gives donkey anti-rabbit 10 horseradish peroxidase in 0.1M phosphate buffer pH 7.5 containing 0.9% (w/v) sodium chloride, 0.1% bovine serum albumin and 0.1% Tween 20.

Wash buffer

15 Bottle contains 12.5 ml phosphate buffer concentrate which on dilution gives a 0.0067M phosphate buffer pH 7.5 containing 0.033% Tween 20.

TMB substrate

20 Bottle contains 3,3',5,5'-tetramethylbenzidine (TMB)/hydrogen peroxide, in dimethylformamide, (20%, v/v) 22 ml, ready for use.

Gelatinolytic activity (Gelatinases)

25 in extracts from tumour and normal tissue from cancer patients.

Assay principle: The assay was performed as a standard gelatin zymographic assay. The principles of the assay is 30 based on electrophoretic separation of tissue extracts on

polyacrylamide gels containing gelatin. Following electrophoretic separation the gels are incubated at 37 °C overnight and stained for protein. Zones of gelatinolytic activity are then observed as clear, unstained bands on the 5 gel.

Assay protocol: Gelatine 300 bloom (Sigma Chemical Co.) was added to the standard Laemmli acrylamide polymerisation 10 mixture (11% Stock Resolving solution) at a final concentration of 3 mg/ml. Polymerisation of gels were obtained after 30 min at room temperature. Stacking gel (4% Stacking gel) was polymerised on top of the main gel (30 min room temperature).

15

Human tissue samples were homogenised (10 mg tissue/ml buffer) in 0.15 M NaCl, pH 7.0, containing 0.1 % Triton X-100, mixed (1:3), before 30 ml were loaded (without boiling and b-mercaptoethanol) into each well of the stacking gel 20 mounted in a BioRad mini-Slab gel apparatus.

Gels were run at 10 mA/gel during resolving phase at 4 °C. After Electrophoresis, gels were soaked in 2.5% Triton-X-100 for 2 hours at room temperature with gentle shaking to 25 elute SDS. The gels were then rinsed, and incubated overnight at 37 °C in a 0.05M Tris-HCl , 0.1 M NaCl, pH 7.6, buffer.



Following incubation the gels were stained for 30 min. in 0.5% Coomassie Blue R-250 in Ethanol:acetic acid:water (30:10:60), destained in Ethanol:acetic acid:water (30:10:60) and photographed.

5

11% Stock Resolving solution

1	Acrylamide(30%) Bis. (1%) in Water	3,30 ml
2	1,5 M Tris-HCl. PH:8,8 + 0,4% SDS	2,25 ml
3	Gelatine 300 bloom 3g% in distilled water	0,9 ml
4	Ammonium persulphate: 100 mg/ml in water	0,02 ml
5	TEMED (N,N,N',N',-tetramethyl-ethylenediamine)	0,01 ml
6	Water	2,55 ml
	Total Volume	9,03 ml

10 4% Stacking gel:

1	Acrylamide(30%) Bis. (1%) in Water	0,40 ml
2	0,5 M Tris-HCl. PH:6,8 + 0,4% SDS	0,50 ml
3	Ammonium persulphate: 100 mg/ml in water	0,04 ml
4	TEMED	0,02 ml
5	Water	3,10 ml
6	Total Volume	4,06 ml

Sample Buffer: Without b-mercaptoethanol,

1	Water	4,0 ml
2	0,5 M Tris-HCl. PH:6,8	1,0 ml
3	Glycerol	0,8 ml
4	10% SDS	1,6 ml
5	0,1% Bromphenol.Blue	0,2 ml

5 Reservoir Buffer: 5X electrophoresis buffer Laemmli method.

1	Tris base	15g/l
2	Glycin	72g/L
3	SDS	5g/L

#### EXAMPLES

10

#### EXAMPLE 1

#### Isolation and purification of the anthocyanin samples

15 Samples

- PG: pelargonidin 3-O-b-D-glucopyranoside  
 SA: cyanidin 3-O-b-D-glucopyranoside  
 SB: petanin (partly purified, see Figures 5 and 6)  
 20 SC: cyanidin 3-O-(6''-a-L-rhamnopyranosyl-b-D-glucopyranoside) and delphidin 3-O-(6''-a-L-rhamnopyranosyl-b-D-glucopyranoside) (content ca. 1:1).  
 SP: petanin (See Figure 6 for structure)

VA-1 Mixture of anthocyanins from blueberries (*Vaccinium myrtillus* L.)

VA-2: Mixture of anthocyanins from blueberries (*Vaccinium myrtillus* L.)

5

### Extraction

#### PG

10 Ripe fruits of strawberry (*Fragaria ananassa* var. Corona) were purchased at the local food market. The frozen fruits (500 g) were extracted twice for 14 hours in the refrigerator, with 500 ml of methanol containing 0.07% v/v concentrated hydrochloric acid.

15

#### SA and SC

Ripe fruits of black current (*Ribes nigrum* L.) were collected at Foldøy in Ryfylke on the West coast of Norway. The frozen fruits (450 g) were extracted three times for 14 hours in the refrigerator with 500 ml of methanol containing 0.5% v/v concentrated hydrochloric acid.

20

#### SB and SP

Tubers of *Solanum tuberosum* L. (anthocyanin pigmentation in skin and flesh) from cultivation at the Agricultural University of Norway, NLH-Ås, Norway, were cut with a pair of scissors and extracted for 3 hours (three times) with methanol containing 0.1% v/v concentrated hydrochloric acid.

25

#### 30 VA-1 and VA-2

Ripe berries of *Vaccinium myrtillus* L. were collected in Åsane near Bergen on the West coast of Norway. The frozen berries (100 g) were extracted for 5 hours (twice) with 500 ml of methanol containing 0.05% v/v concentrated hydrochloric acid.

35

Procedures for purification of the samples

For all samples: The filtered extracts were combined and concentrated under reduced pressure at 28°C. The concentrated solutions (ca. 100 ml) were washed twice with ca. 100 ml ethyl acetate, and the lower layers were further concentrated under reduced pressure at 28°C before they were passed through an 18 cm x 2.6 cm Amberlite XAD-7 column (an ion exchange resin from BDH Chemicals Ltd.) which had been washed in advance with distilled water. The XAD-7 column (with the adsorbed anthocyanins) was washed with ca. 2 l of distilled water. To elute the anthocyanins, ca. 300 ml each of 50 % aqueous methanol and anhydrous methanol (both containing 0.5% v/v CF<sub>3</sub>COOH) were used successively. The samples were then concentrated under reduced pressure at 28°C. The samples containing PG, SA and SC, and SP were individually subjected to droplet counter-current chromatography.

## Droplet counter-current chromatography (DCCC)

20

DCCC was carried out using a Tokyo Rikakikai Eyela Model DCC-300 chromatograph fitted with 300 glass capillaries (40 cm x 2 mm i.d.).

25 For PG, the lower layer of *n*-butanol-acetic acid-water (4:1:5, v/v) was used as mobile phase. A flow rate of 10 ml/hour were used throughout the experiment. Some stationary phase (100 ml) was displaced prior to elution of the first drop of mobile phase. Then 100 fractions, each of 5 ml, were collected.

30 Fractions 54-100 were collected and concentrated under reduced pressure at 28°C.

For the sample containing both SA and SC, the upper layer of *n*-butanol-acetic acid-water (4:1:5, v/v) was used as mobile phase. A flow rate of 10 ml/hour was used throughout the experiment. Some stationary phase (100 ml) was displaced prior

to elution of the first drop of mobile phase. Then 90 fractions, each of 5 ml, were collected. Fractions 36-42 were collected and concentrated under reduced pressure at 28°C (Sample SA). Fractions 55-90 were collected and concentrated 5 under reduced pressure at 28°C (Sample SC).

For SP, the upper layer of *n*-butanol-acetic acid-water (4:1:5, v/v) was used as mobile phase. A flow rate of 10 ml/hour was used throughout the experiment. Some stationary phase (100 ml) 10 was displaced prior to elution of the first drop of mobile phase. Then 45 fractions, each of 7 ml, were collected. Fractions 12-35 were collected and concentrated under reduced pressure at 28°C.

15 For VA-1, the lower layer of *n*-butanol-acetic acid-water (4:1:5, v/v) was used as mobile phase. A flow rate of 10 ml/hour were used throughout the experiment. Some stationary phase (150 ml) was displaced prior to elution of the first drop of mobile phase. Then 160 fractions, each of 4 ml, were 20 collected. Fractions 20-100 were collected and concentrated under reduced pressure at 28°C.

For VA-2, the lower layer of *n*-butanol-acetic acid-water (4:1:5, v/v) was used as mobile phase. A flow rate of 9 ml/hour 25 was used throughout the experiment. Some stationary phase (110 ml) was displaced prior to elution of the first drop of mobile phase. Then 150 fractions, each of 4 ml, were collected. Fractions 13-15 were collected and concentrated under reduced pressure at 28°C.

30

The samples containing PG, SA, SC, SP; VA-1, and VA-2 were individually subjected to Sephadex LH-20 chromatography.

### Sephadex LH-20 chromatography

Sephadex LH-20 chromatography was performed on a 100 cm x 3 cm column using 40% v/v aqueous methanol containing 1% v/v  $\text{CF}_3\text{COOH}$  as eluent. All the anthocyanin coloured fractions belonging to each sample were put together and evaporated to dryness under reduced pressure at 28°C.

### Monitoring of fractions

10

Thin-layer chromatography (TLC) analyses were performed on 0.1 mm cellulose layers (Schleicher and Schüll, F1440) in the following solvent systems:

- A. Formic acid-concentrated hydrochloric acid-water (5:1:5, v/v)
- B. n-Butanol-acetic acid-water (4:1:5, v/v, upper phase).

High performance liquid chromatography (HPLC) was carried out using a slurry packed ODS-Hypersil column 20 x 0.5 cm, 5 mm). Two solvents were used for elution (A: formic acid-water (1:9, v/v) and B: formic-acid-water-methanol (1:4:5, v/v). Several slightly different elution profiles were used: A typical elution profile was composed of isocratic elution (90% v/v A, 10% B) over 4 min, linear gradient from 10% v/v B to 100% B over the next 17 min, followed by linear gradient from 100% B to 10% v/v B over 1 min. The flow rate was 1.5 ml min<sup>-1</sup>, and aliquots of 10 ml were injected.

### Determination of relative quantities

30

The relative quantities of the individual anthocyanins in the purified *Vaccinium myrtillus* samples (VA-1 and VA-2) were based on integration of the different peaks in the HPLC chromatograms (Figure 9 and Figure 11) of the purified samples. These chromatograms were recorded by measuring the absorption values on every second nm between 500 and 540 nm simultaneously, and

do not take into account the different molar absorption coefficients of the individual anthocyanins.

## 5 Identification

The identities of the individual anthocyanins were determined by a combination of co-chromatography (HPLC and TLC), degradation techniques, UV-visible  
10 spectroscopy, and one- and two-dimensional NMR techniques (Andersen, Ø.M. (1989). Dr. philos.-thesis University of Bergen. ISBN 82-7406-002-4; Andersen, Ø.M. (1988). Acta Chem. Scand. 42, 462; Andersen, Ø.M., Opheim, S., Aksnes, D.W., and Frøystein, N.Å. (1991). Phytochemical Analysis.  
15 2, 230.)

## EXAMPLE 2

20 Determination of cytotoxic and antiviral effects in HIV infected cells in three different extracts containing compounds or mixtures of compounds according to the invention

The cytotoxic effect and the antiviral effect in HIV infected  
25 cells of the three extracts obtained according to Example 1 were tested as described in Test Methods, sections 2 and 3.

Cytotoxic effect of a compound or mixture of compounds is defined here as the concentration of the compound or mixture of  
30 compounds which effects the growth rate of the cells tested. Here, a cytotoxic effect of a compound or mixture of compounds is considered present if a decrease in OD<sub>580</sub> of more than 10% is observed as a result of incubation with the compound or mixture

of compounds. With respect to the cytotoxic effect, the results are shown in Figure 3.

An antiviral effect is here considered present if a decrease in syncytia formation of more than 10% is observed as a result of incubation with the compound or mixture of compounds. With respect to the antiviral effect, the results are shown in Figure 4 wherein for each compound or mixture of compounds the inhibition of formation of syncytia is shown as a percentage of the formation of syncytia in untreated cells.

In Figure 6 are shown the results after 24 hours and/or 48 hours. At 48 hours the same pattern is observed although the total amount of syncytia is higher. The compound has a clear inhibitory effect on the cytopathogenic effect of HIV although complete inhibition of syncytia formation cannot be obtained at the experimental conditions used.

#### I Cytotoxic and antiviral effect of Sample SP

20

At concentrations between 0.02 and 0.2 mg/ml, a cytotoxic effect on cell growth rate is observed (Figure 3).

At concentrations above 1 mg/ml, an antiviral effect is observed (Figure 6).

#### EXAMPLE 3

Inhibition of pelargonidin 3-glucoside (Sample PG) on  
30 proteolytic enzymes



Pelargonidin 3- glucoside (Pg 3-glc) was tested in tissue extracts from a normal intestinal mucosa from rat. Inhibition of the proteolytic enzymes is found in a range of about 12-5 30 % (see the table below). Furthermore, 0.5 mM pelargonidin 3- glucoside has been found to inhibit the uptake of neutral red in LLC-PK1 cells by 16%.

Inhibition of rat control with pelargonidin 3-glucoside (0.23 10 mM corresponding to 0.1 mg/ml in the incubation solution):

<u>Enzyme</u>	<u>% inhibition</u>
TPP4.5	30.2 $\pm$ 2.3
15 DDP 4	27.0 $\pm$ 0.2
DPP 2	20.3 $\pm$ 1.1
LAP	31.0 $\pm$ 3.1
NAG	12.6 $\pm$ 1.2
Cath.H	12.2 $\pm$ 4.3
20 DDP I	21.3 $\pm$ 0.8
Cath.B	20.6 $\pm$ 1.1

Inhibition of various anthocyanidin samples on Matrix  
Metalloproteinase-1 (MMP-1)

25

Typical results obtained for MMP-1 assayed in extracts from normal a tumour tissue are shown in Figure 13 where effects from all compounds tested (Samples SA, SB and SC) are seen as an inhibition of MMP-1 activity in the tumour from

patient no. 3, 4, 7 and 8. Patient no. 1 - 6 are suffering from colon cancer, while patient no. 7 and 8 are suffering from cancer in the rectum.

5 Determination of Gelationolytic activity (Gelatinases)  
revealed by gelatine zymography

Gelatine-degrading enzymes present in the samples were identified by their ability to clear the substrate (white  
10 zones) at their respective molecular weights.

a. Rectum

Typical results from a patient with rectum cancer are shown in Figure 14. Arrows indicate bands revealing gelatinase  
15 activity in the tumour extract (white zones) inhibited by SA, SB and SC. Note that the corresponding activity with similar banding in the normal tissue is only inhibited by SB.

20 b. Colon

Typical results from a patient with colon cancer are shown in Figure 15. Arrows indicate bands revealing gelatinase activity (white zones) in the tumour extract inhibited by SA, SB and SC.

25

c. Ventricle

Typical results from a patient with ventricle cancer are shown in Figure 16. The arrow indicates gelatinase activity in the tumour extract inhibited by SA, SB and SC.

30

#### d. Pancreas

Typical results from a patient with pancreas cancer are shown in Figure 17. Arrows indicate gelatinase activity in the tumour extract inhibited by SA, SB and SC.

5

#### Control experiments - tumour specific gelatinases

Because some Matrix Metalloproteinases are known to have gelatinolytic activity, test runs were also performed to see whether the tumour specific gelatinolytic activity demonstrated by gelatine zymography was caused by these enzymes. Matrix Metalloproteinases, as the name implies, are dependent on the presence of divalent metal ions for their activity. Tumour extracts from rectum and pancreas were therefore preincubated with chelating agents such as EDTA and EGTA before gelatine zymography. The results obtained are shown in Figure 18 and Figure 19. Neither EDTA nor EGTA had any effect on the gelatinolytic in the tumour extracts demonstrating that the observed activity are not due to Matrix Metalloproteinase activity.

#### Conclusion

To our knowledge the tumour specific gelatinolytic activity found for the anthocyanindin samples have not been reported earlier and represents as such new findings.

Example 4

Tests used to demonstrate whether the test compounds have an anti-neoplastic effect as inhibitor of tumour cell metabolism.

Results - cell counting and viability assay

SA and SB were tested at final concentrations up to 1 mM for their effect on BT4C and BT4Cn cell mortality. Figure 10 20 demonstrate clearly that exposure to both SA and SB increases the mortality from hardly detectable to about 10% in the BT4C cells. In the BT4Cn cells SB gave an increased mortality from 6% to 12%, while no increasing effect was seen from SA at the concentrations tested. Only minor 15 effects were observed on the total cell number after exposure to SA or SB up to a final concentration of 1 mM.

Results - cytotoxicity assay (Neutral red)

The results obtained for cytotoxicity of anthocyanidin 20 derivatives tested on BT4C cells are shown in Figure 21 and on BT4Cn cells are shown in Figure 22. Both compounds were found to reduce neutral red uptake in both cell lines. A similar effect was observed for both SA and SB on BT4C cells where the neutral red uptake was reduced by about 50% 25 by 1 mM SA or SB. A similar effect of about 50% inhibition was seen from SB on BT4Cn cells where SA reduced the uptake by 25-30%.

Morphological observation

Before neutral red was added to BT4C and BT4Cn cells both cells were observed to have accumulated the anthocyanidin derivatives tested (data not shown).

5

Conclusion:

The Neutral red cytotoxicity assay demonstrate that both SA and SB have cytotoxic effects on the brain tumour cell lines BT4C and BT4Cn. Also the anthocyanidin derivatives  
10 tested are taken up by these cell lines.

## EXAMPLE 5

LLCPK1 and BT4Cn cells exposed to sample SB

15

The established renal epithelial cell line LLC-PK1, which has characteristics reminiscent of those of proximal tubular cells (Hull RN, Cherry WR, Weaver GM: The origin and characteristics of a pig kidney strain LLC-PK1. In  
20 Vitro 12: 670-677, 1976), has been extensively studied in monolayer cultures.

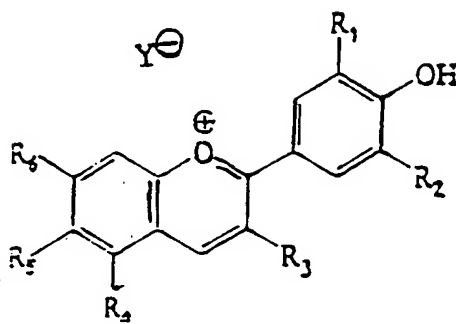
LLC-PK1 cells (CRL 1392; American Type Culture Collection, Rockville, MD, USA) were originally obtained from Flow  
25 Laboratories (Irvine, UK) at passage number 202. The cells described in this study were grown from passage number 217-238 in Eagle-Dulbecco's modified medium (Gibco, Grand Island, NY) with 10% new-born calf serum and four times the prescribed concentration of nonessential amino acids, 2% L-

glutamine, penicillin (100 IU/ml) and streptomycin (100 mg/ml). Cell cultures were routinely maintained at 37°C at 100% relative humidity in an atmosphere of 5% CO<sub>2</sub>/95% air

5 A 24 well plate was seeded with BT<sub>2</sub>Cn cells and another plate with LLC<sub>PK</sub>-1 cells at about 30 000 per well. They were grown to semiconfluency, and then exposed to 0, 0.2, 0.4, 0.6, 0.8, 1.0 mM of sample SB for about 24 hours. Then the cells were trypsinized and counted manually for living and dead cells with Trypan blue, using Hemocytometer slide.

CLAIMS

1. The use of an anthocyanidin or an anthocyanidin derivative  
5 of the general formula I



wherein

$R_1$ ,  $R_2$ ,  $R_3$  and  $R_6$  independently of each other are H, OH, alkoxy,  
10 an -O-glycosyl group, an -O-glycosyl group which is substituted  
with one or more acyl groups, or an -O-glycosyl moiety compris-  
ing at least two glycosyl groups and at least one acyl group  
arranged so that at least one acyl group is located between two  
glycosyl groups,

15

$R_4$  is OH, alkoxy, an -O-glycosyl group, an -O-glycosyl group  
which is substituted with one or one acyl groups, or an -O-  
glycosyl moiety comprising at least two glycosyl groups and at  
least one acyl group arranged so that at least one acyl group  
20 is located between two glycosyl groups,

$R_5$  is H, OH, and

Y is a counterion,

or a salt, prodrug, a chemical modification or complex thereof for the preparation of a pharmaceutical composition for the prevention and/or treatment of neoplastic disorders, diseases  
5 caused by lesions in connective tissues or a disease caused by a virus in a mammal including a primate such as a human.

2. The use according to claim 1, wherein the anthocyanidin or the anthocyanidin derivative, when dissolved in DMSO at a con-  
10 centration so that the final concentration of DMSO does not exceed 0.2% v/v DMSO, when tested as described in section 2.3, the anthocyanidin or the anthocyanidin derivative does not have a cytotoxic effect on the growth of uninfected SupT1 cells resulting in a decrease in OD<sub>580</sub> of more than 10% as a result of  
15 incubation with the anthocyanidin or the anthocyanidin derivative.

3. The use according to claim 1 or 2, wherein alkoxy is selected from the group consisting of methoxy, ethoxy, propoxy,  
20 isopropoxy, and butoxy.

4. The use according to claim 3, wherein R<sub>1</sub>, R<sub>2</sub>, R<sub>3</sub>, and/or R<sub>4</sub> is methoxy.

25 5. The use according to any of claims 1-4, wherein at least one of R<sub>1</sub> and R<sub>2</sub> is H.

6. The use according to any of claims 1-4, wherein at least one of R<sub>1</sub> and R<sub>2</sub> is OH.



7. The use according to any of claims 1-3, wherein at least one of  $R_1$  and  $R_2$  is alkoxy.

8. The use according to claim 1, wherein the anthocyanin or the  
5 anthocyanin derivative is as outlined in claim 1 with the exception of the compounds; pelargonidin, cyanidin, delphinidin and chrysanthemin.

9. The use of an anthocyanidin or an anthocyanidin derivative  
10 according to claim 8 for the preparation of a pharmaceutical composition for the prevention and/or treatment of neoplastic disorders.

10. The use according to claim 1, wherein the anthocyanin or  
15 the anthocyanin derivative is as outlined in claim 1 with the exception of the compounds; pelargonidin, cyanidin and delphinidin.

11. The use of an anthocyanidin or an anthocyanidin derivative  
20 according to claim 8 for the preparation of a pharmaceutical composition for the prevention and/or treatment of diseases caused by lesions in connective tissues.

12. The use according to claim 5, wherein wherein the the  
25 anthocyanin or the anthocyanin derivative is derived from an anthocyanidin selected from the group consisting of pelargonidin, apigeninidin, and aurantinidin.

13. The use according to claim 6, wherein the anthocyanin or the anthocyanin derivative is derived from an anthocyanidin selected from the group consisting of cyanidin, delphinidin, luteolinidin, tricetinidin, 6-hydroxy-cyanidin, 6-hydroxy-  
5 delphinidin, 5-methyl-cyanidin, and pulchellidin.

14. The use according to claim 7, wherein the anthocyanin or the anthocyanin derivative is derived from an anthocyanidin selected from the group consisting of peonidin, petunidin,  
10 malvidin, rosinidin, europinidin, hirsutidin, and capensinidin.

15. The use according to any of the preceding claims, wherein the glycosyloxy is selected from the group consisting of mono-, di-, tri-, oligo-, polysaccharides, and derivatives thereof.  
15

16. The use according to claim 15, wherein the glycosyl group is substituted with one or more acyl groups, or the glycosyl moiety comprises at least two glycosyl groups and at least one acyl group arranged so that at least one acyl group is located  
20 between two glycosyl groups.

17. The use according to claim 16, wherein the acyl group is selected from the group consisting of aromatic and aliphatic acyl groups.

25

18. The use according to claim 17, wherein the acyl group is selected from the group consisting of acyl groups derived from 4-coumaric acid, caffeic acid, ferulic acid, sinapic acid, 4-hydroxybenzoic acid, gallic acid, acetic acid, oxalic acid,  
30 malonic acid, malic acid, maleic acid, and succinic acid.

19. The use according to any one of claims 15-18, wherein the glycosyl group is a group derived from a monosaccharide selected from the group consisting of glucose, galactose,  
5 rhamnose, arabinose, xylose, and glucuronic acid.

20. The use according to any one of claims 15-18, wherein the glycosyl group is a group derived from a disaccharide selected from the group consisting of 1,2-glucosylglucoside (sophorose),  
10 1,3-glucosylglucoside (laminariobiose), 1,6-glucosylglucoside (gentiobiose), 1,2-xylosylgalactoside (lathyrose), 1,2-rhamnosylglucoside (neohesperidose), 1,6-rhamnosylglucoside (rutinose), 1,2-xylosylglucoside (sambubiose), 1,6-arabinosylglucoside, and 1,6-rhamnosylgalactoside.

15

21. The use according to any one of claims 15-18, wherein the glycosyl group is a group derived from a trisaccharide selected from the group consisting of 1,2-glucosyl-1,6-glucosylglucoside, 1,2-glucosyl-1,6-rhamnosylglucoside, 1,2-xylosyl-  
20 1,6-glucosylglucoside, and 1,2-xylosyl-1,6-glucosylgalactoside.

22. The use according to claim 1, wherein at least one of  $R_3$ ,  $R_4$ , and  $R_6$  is an -O-glycosyl, an -O-glycosyl group which is substituted with at least one acyl group, or an -O-glycosyl moiety  
25 comprising at least two glycosyl groups and at least one acyl group arranged so that at least one acyl group is located between two glycosyl groups.

23. The use according to claim 1, wherein

R<sub>1</sub> is OCH<sub>3</sub>,

R<sub>2</sub> is OH,

R<sub>3</sub> is 6-O-(4-O-E-p-coumaroyl- $\alpha$ -L-rhamnopyranosyl)- $\beta$ -D-glucopyranosyl,

R<sub>4</sub> is  $\beta$ -D-glucopyranosyl,

R<sub>5</sub> is H,

and R<sub>6</sub> is OH.

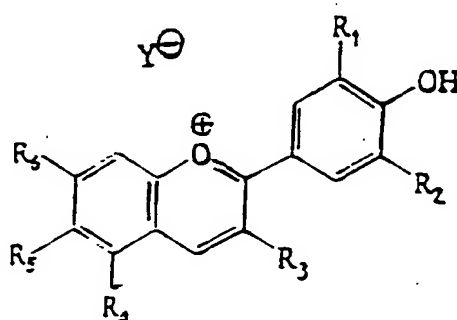
24. The use according to claim 1, wherein the composition consists of the individual anthocyanins outlined in Table I, preferably in the relative quantities outlined in the table.

25. The use according to claim 1, wherein the composition consists of the individual anthocyanins outlined in Table II, preferably in the relative quantities outlined in the table.

26. The use according to any of the preceding claims, wherein the virus is selected from the group consisting of parvovira; papovavira, such as papilloma virus; adenovira; herpesvira such as Epstein-Barr virus, cytomegalovirus, herpes simplex vira (HSV 1 and HSV 2), varicella, herpes zoster virus, hepatitis A, hepatitis B; poxvira such as vaccinia, smallpox, molluscum contagiosum, cowpox, and monkey pox virus; hepadnavira; picornavira such as rhinovira and enterovira; reovira such as rotavirus and orbivirus; arbovira such as togavirus, flavi-, bunya-, rhabdo-, arena-, and reovira; coronavira; leukaemia, and sarcoma vira; orthomyxovira such as influenza

vira; paramyxovira such as mumps virus, measles virus, parainfluenza virus, and RSV; and other unclassified viruses such as lentivira, non-A, non-B hepatitis vira, and viroids.

5 27. A novel anthocyanin derivative of the general formula I



wherein

$R_1$ ,  $R_2$ ,  $R_3$  and  $R_6$  independently of each other are H, OH, alkoxy,  
 10 an -O-glycosyl group, an -O-glycosyl group which is substituted  
 with one or more acyl groups, or an -O-glycosyl moiety compris-  
 ing at least two glycosyl groups and at least one acyl group  
 arranged so that at least one acyl group is located between two  
 glycosyl groups,

15

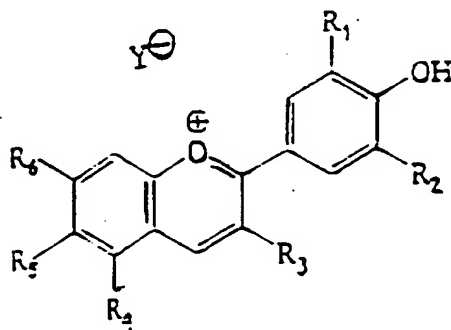
$R_4$  is OH, alkoxy, an -O-glycosyl, an -O-glycosyl group which is  
 substituted with one or one acyl groups, or an -O-glycosyl  
 moiety comprising at least two glycosyl groups and at least one  
 acyl group arranged so that at least one acyl group is located  
 20 between two glycosyl groups,

$R_5$  is H, OH, and

Y is a counterion,

or a prodrug, a chemical modification or complex thereof with the exception of the compounds mentioned in "The Flavonoids", ed. J. B. Harborne, T.J. Mabry and H. Mabry, Chapman & Hall, 1975, "The Flavonoids. Advances in Research", ed. J.B. Harborne and T.J. Mabry, Chapman & Hall, 1982, "The Flavonoids. Advances in Research since 1980", ed. J.B. Harborne, Chapman & Hall, 1988, "The Flavonoids. Advances in Research since 1986", ed. J.B. Harborne, Chapman & Hall, 1994 and in references in Chemical Abstract, Vol. 119 and 123 under the General Subject Index entry Anthocyanins.

28. A pharmaceutical composition comprising an anthocyanidin or anthocyanidin derivative of the general formula I



wherein

$R_1$ ,  $R_2$ ,  $R_3$  and  $R_6$  independently of each other are H, OH, alkoxy, an -O-glycosyl group, an -O-glycosyl group which is substituted with one or more acyl groups, or an -O-glycosyl moiety comprising at least two glycosyl groups and at least one acyl group arranged so that at least one acyl group is located between two glycosyl groups,

R<sub>4</sub> is OH, alkoxy, an -O-glycosyl, an -O-glycosyl group which is substituted with one or one acyl groups, or an -O-glycosyl moiety comprising at least two glycosyl groups and at least one acyl group arranged so that at least one acyl group is located  
5 between two glycosyl groups,

R<sub>5</sub> is H, OH, and

Y is a counterion,

10

or a prodrug, a chemical modification or complex thereof with the exception of Myrtocyan® (*Vaccinium myrtillus* anthocyanosides corresponding to 25% as anthocyanidines), topical medicinal compositions containing fruit juice or  
15 fermented fruit juice as described in CA 1086651, a topical composition consisting of an isopropanol extraction of mountain ash berries as described in US 4,132,782, the alcoholic extracts of anthocyanosides described in FR 2456747, the compositions comprising bilberry anthocyanidines, grape anthocyani-  
20 dines or elder anthocyanidines described in GB 1,589,294 and the anthocyanidin glycosides extracted from bilberries, black currents and blackberries described in US 3,546,337.

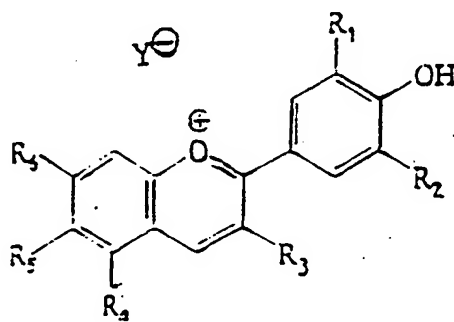
29. A pharmaceutical composition comprising petanin in combina-  
25 tion with a pharmaceutically acceptable excipient.

30. A pharmaceutical composition comprising a novel anthocyanin derivative according to claim 27 in combination with a pharmaceutically acceptable excipient.

30

31. A method for the preparation of an anthocyanidin or an anthocyanidin derivative of the general formula I as defined in claim 27, the method comprising isolation and purification of the anthocyanidin or an anthocyanidin derivative by the methods 5 outlined in Example 1.

32. A method for the prevention and/or treatment of neoplastic disorders, diseases caused by lesions in connective tissues or a disease caused by a virus, the method comprising 10 administering to a mammal in need thereof an effective amount of an anthocyanin derivative of the general formula I



wherein

15  $R_1$ ,  $R_2$ ,  $R_3$  and  $R_6$  independently of each other are H, OH, alkoxy, an -O-glycosyl group, an -O-glycosyl group which is substituted with one or more acyl groups, or an -O-glycosyl moiety comprising at least two glycosyl groups and at least one acyl group arranged so that at least one acyl group is located between two 20 glycosyl groups,

$R_4$  is OH, alkoxy, an -O-glycosyl group, an -O-glycosyl group which is substituted with one or one acyl groups, or an -O-glycosyl moiety comprising at least two glycosyl groups and at



least one acyl group arranged so that at least one acyl group is located between two glycosyl groups,

$R_5$  is H, OH, and

5

Y is a counterion,

or a prodrug, a chemical modification or complex thereof.

- 10 33. A method according to claim 32, wherein the virus is selected from the group consisting of parvovira; papovavira, such as papilloma virus; andenovira; herpesvira such as Epstein-Barr virus, cytomegalovirus, herpes simplex vira (HSV 1 and HSV 2), varicella, herpex zoster virus, hepatitis A,  
15 hepatitis B; poxvira such as vaccinia, smallpox, molluscum contagiosum, cowpox, and monkey pox virus; hepadnavira; picornavira such as rhinovira and enterovira; reovira such as rotavirus and orbivirus; arbovira such as toga-, flavi-, bunya-, rhabdo-, arena-, and reovira; coronavira; leukaemia,  
20 and sarcoma vira; orthomyxovira such as influenza vira; paramyxovira such as mumps virus, measles virus, parainfluenza virus, and RSV; and other unclassified viruses such as lentivira, non-A, non-B hepatitis vira, and viroids.

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## STANDARD GRAPH FOR THE MTT ASSAY

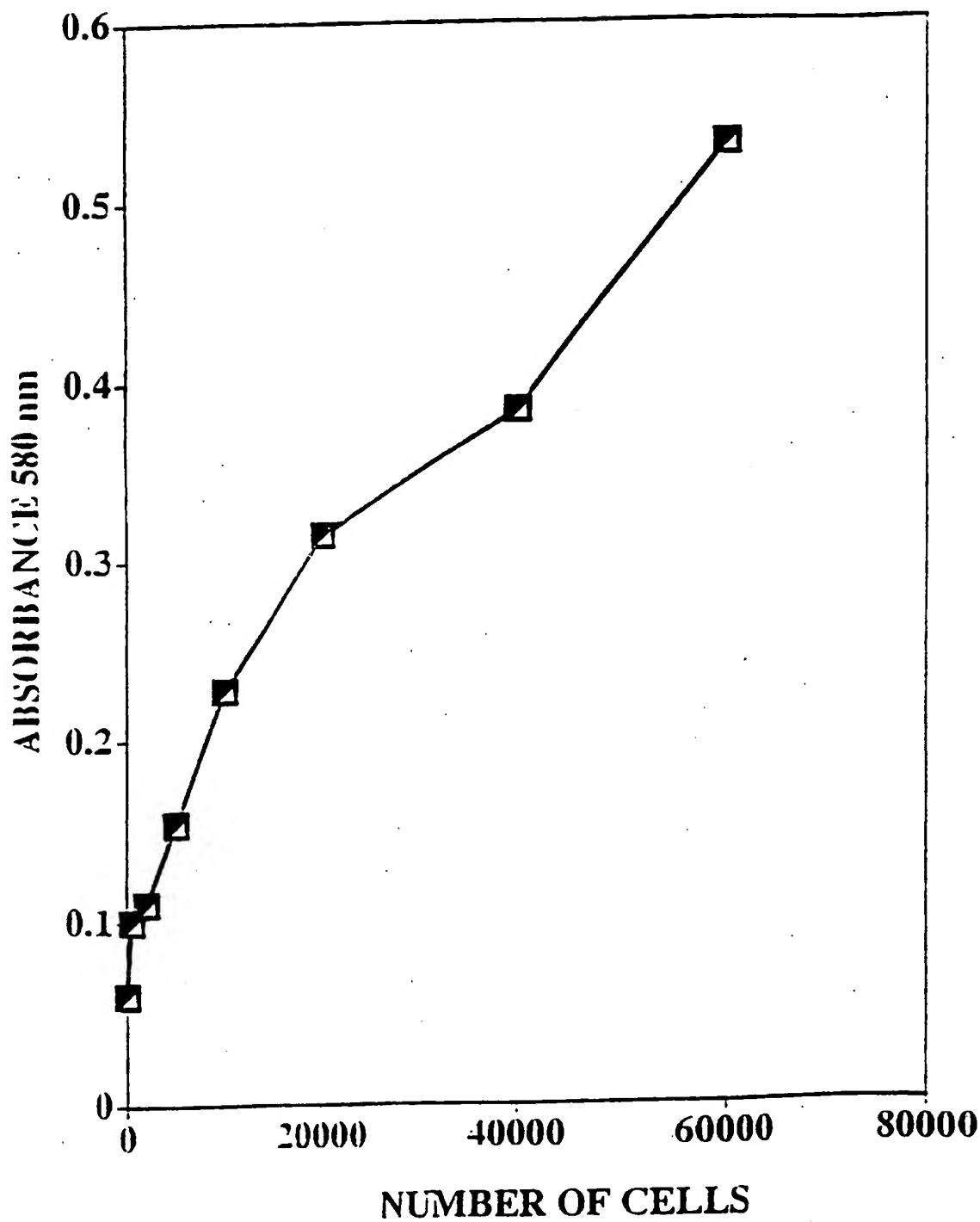
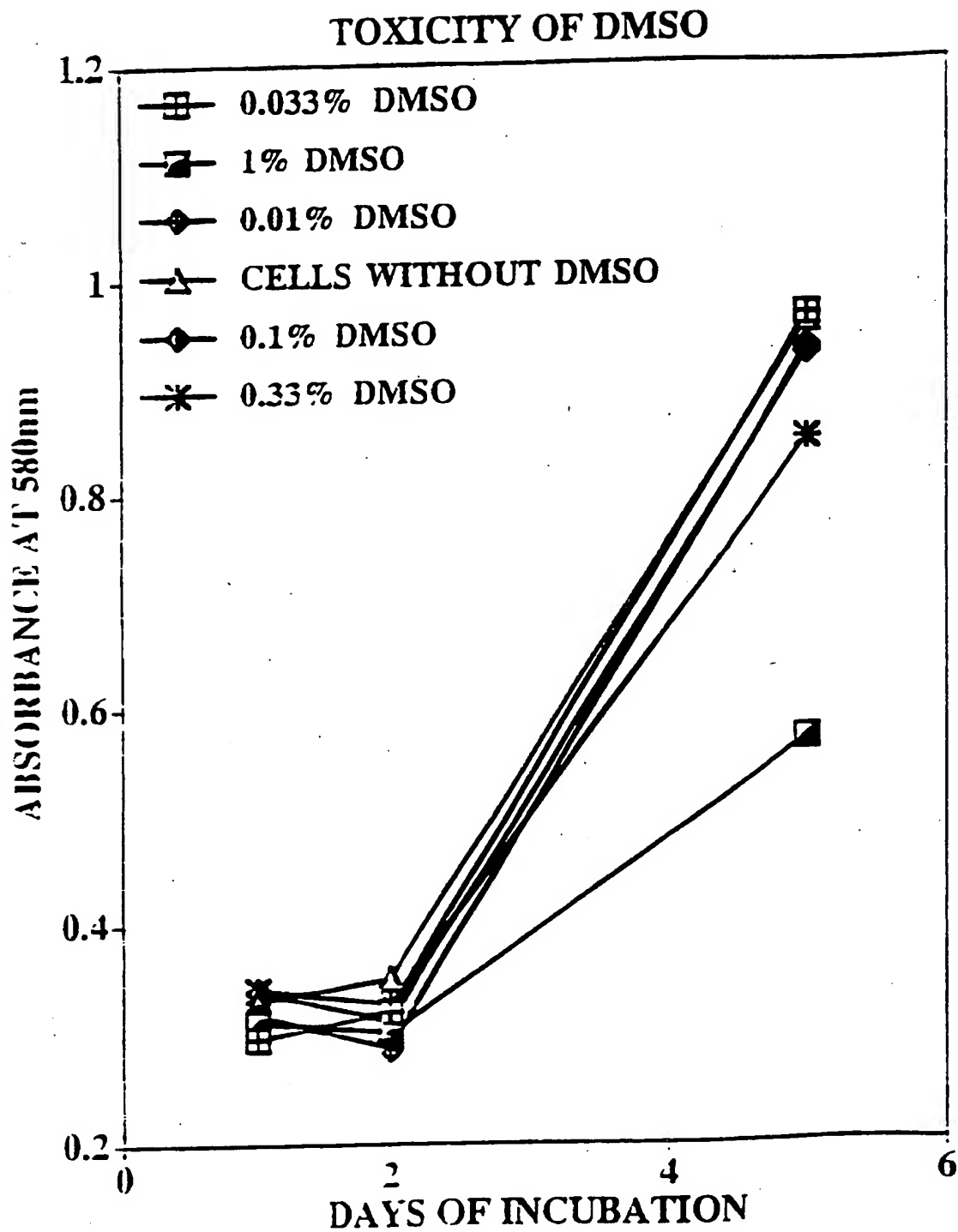


Figure 1

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**Figure 2**

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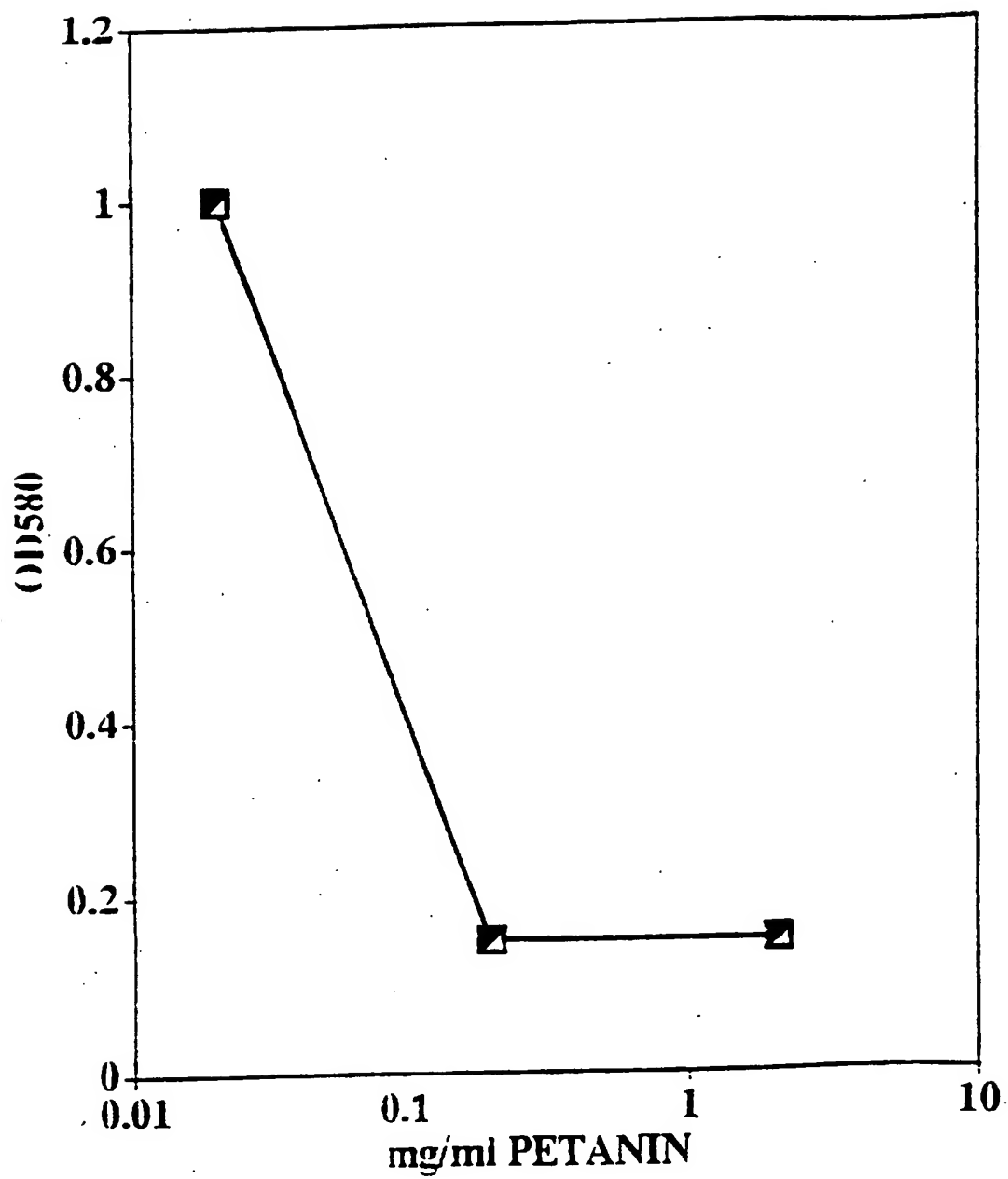


Figure 3

SUBSTITUTE SHEET (RULE 26)

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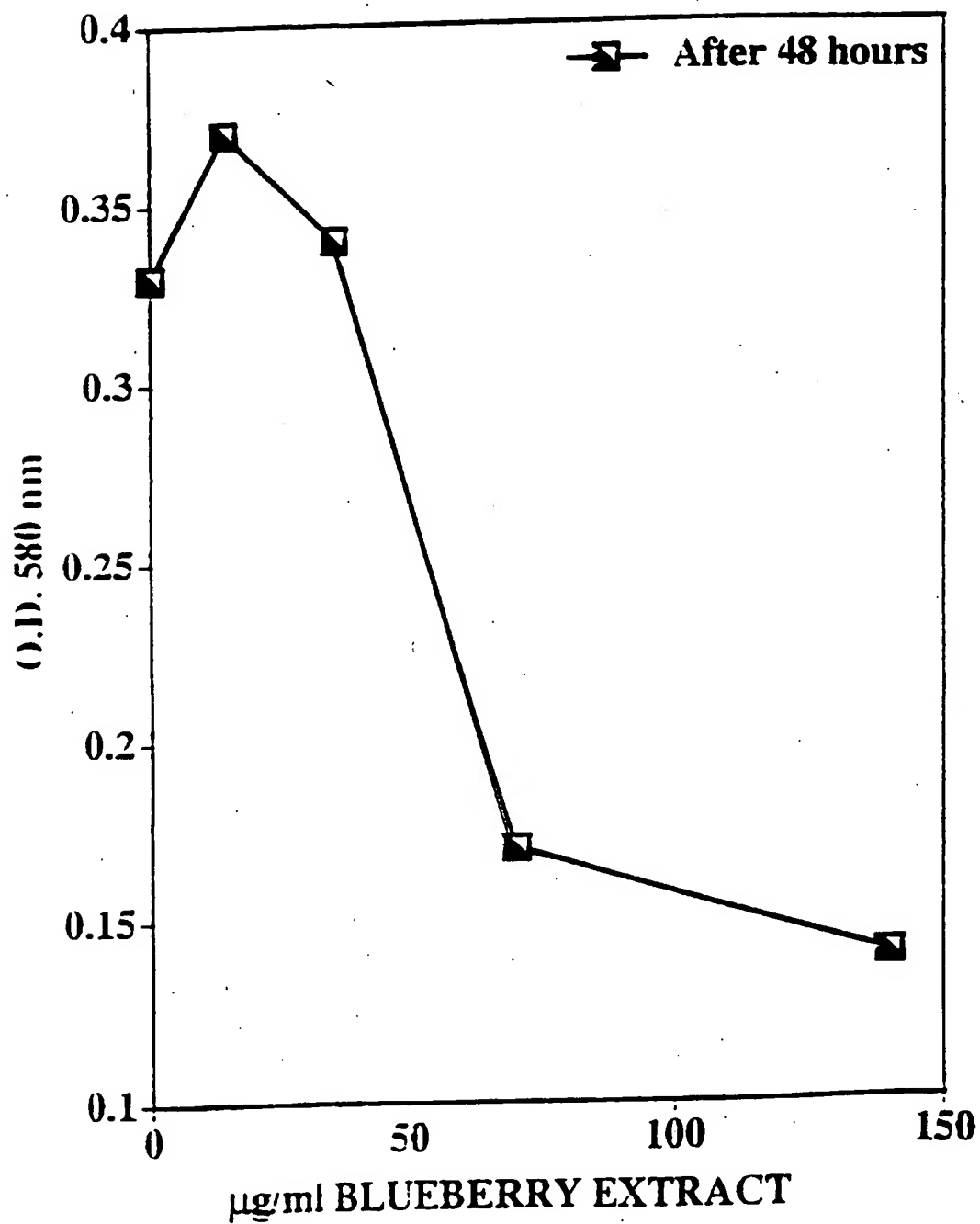


Figure 4

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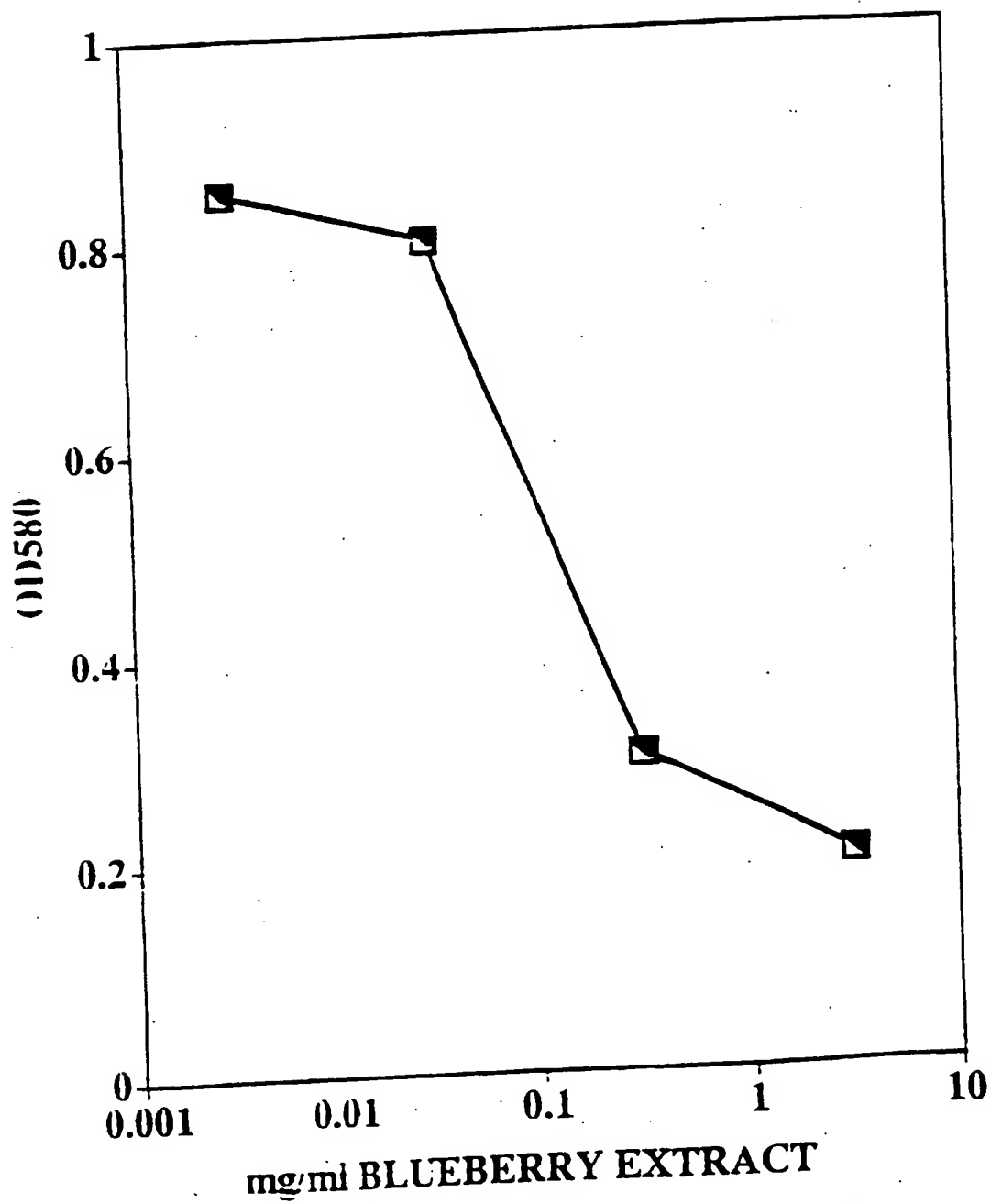
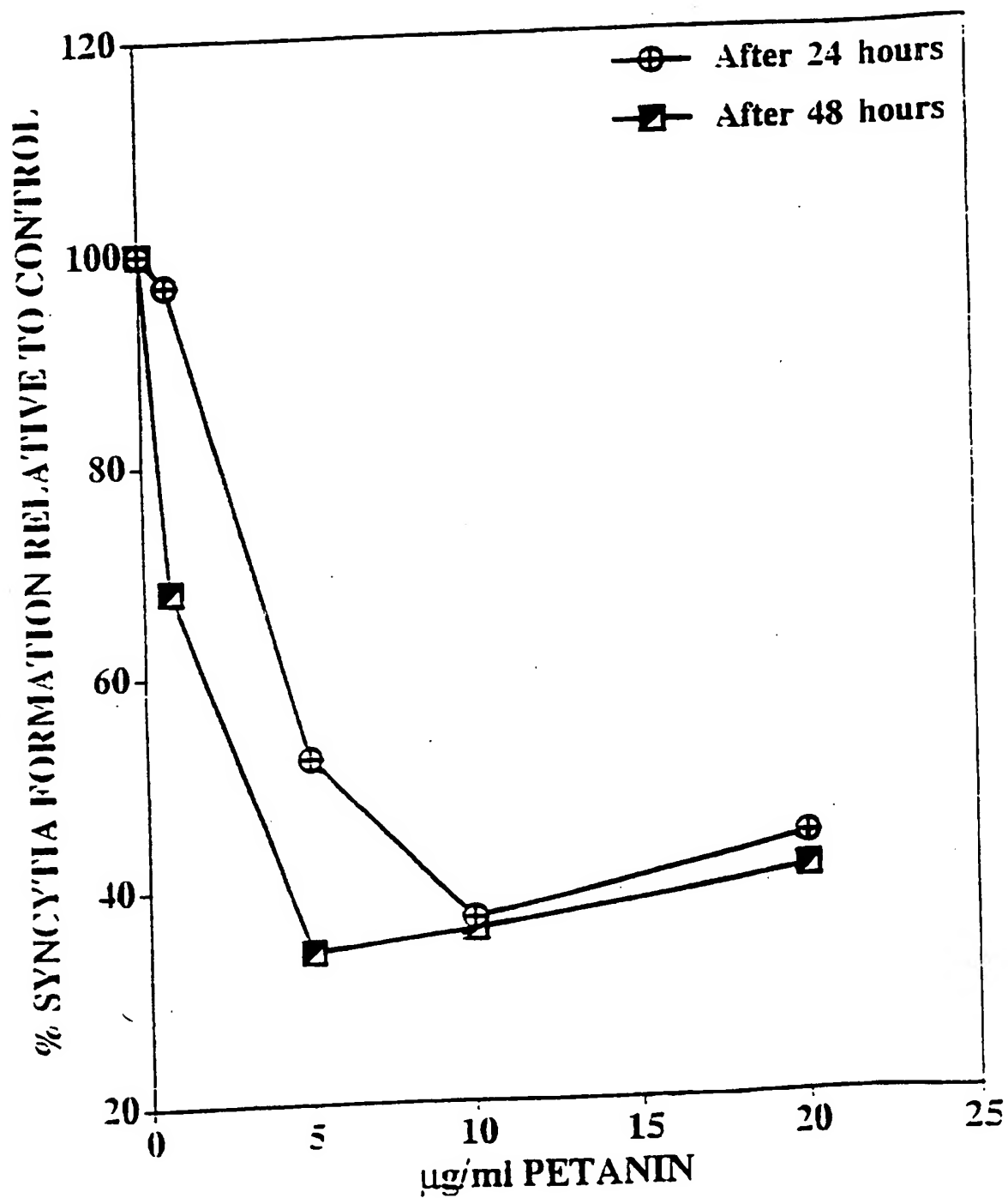


Figure 5

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**Figure 6**

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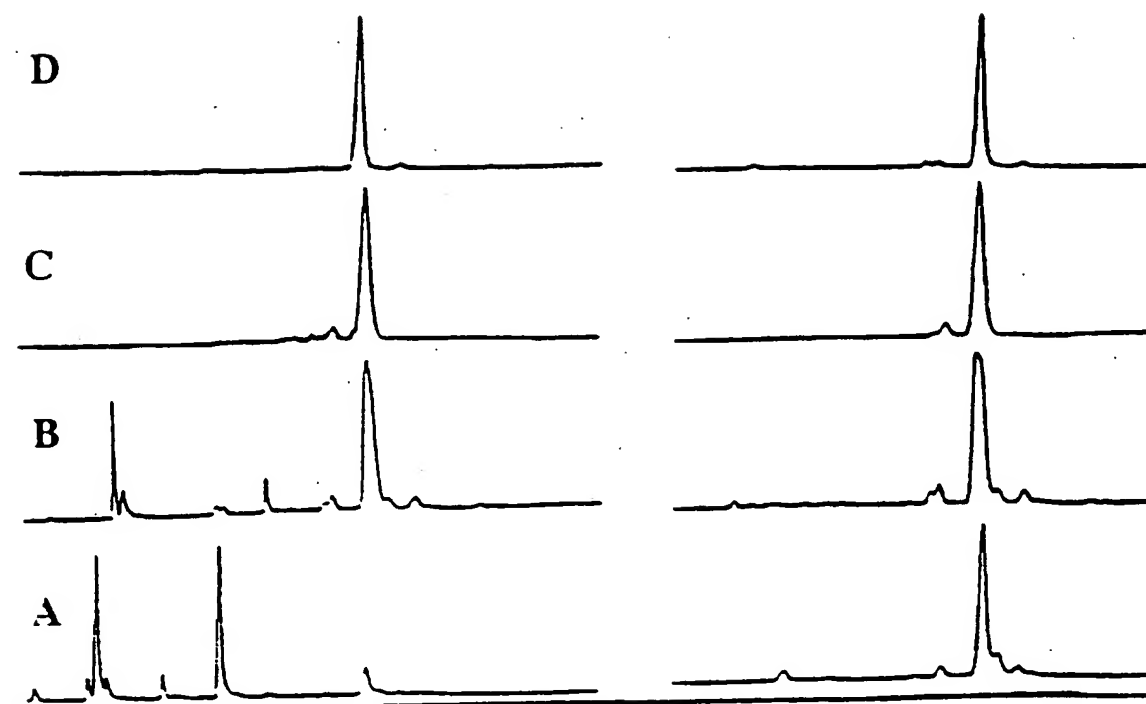
i)  $315 \pm 15$  nmii)  $520 \pm 20$  nm

Figure 7



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The structure of Petanin isolated from *Solanum tuberosum*

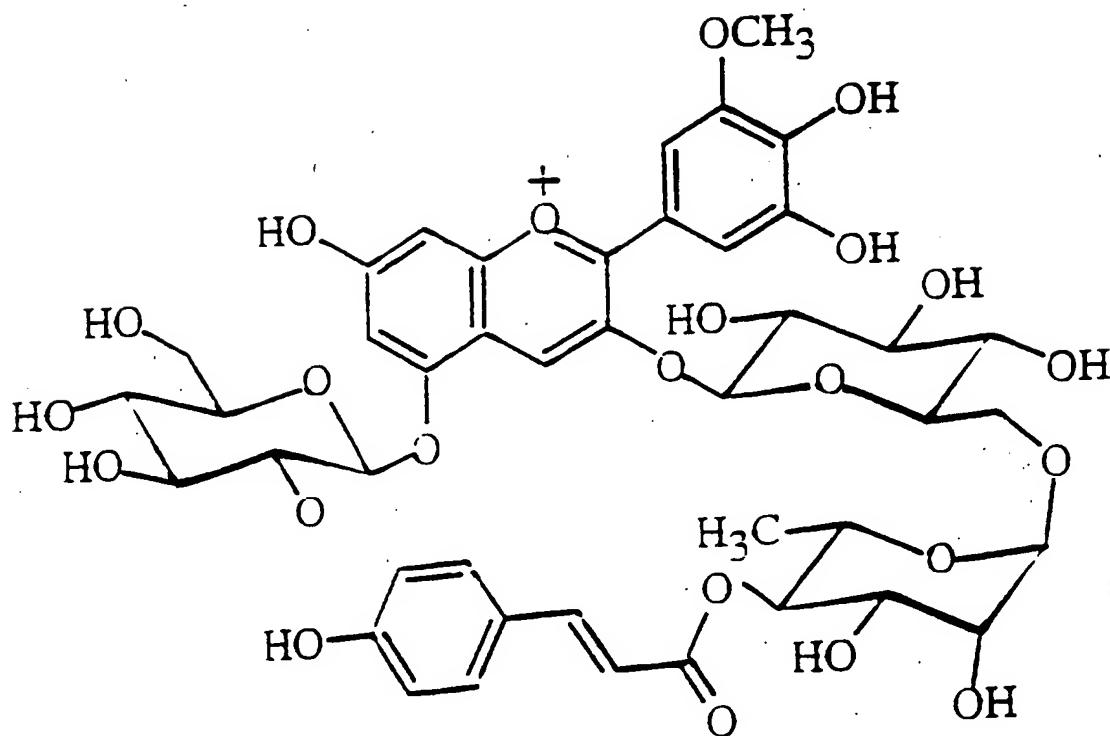
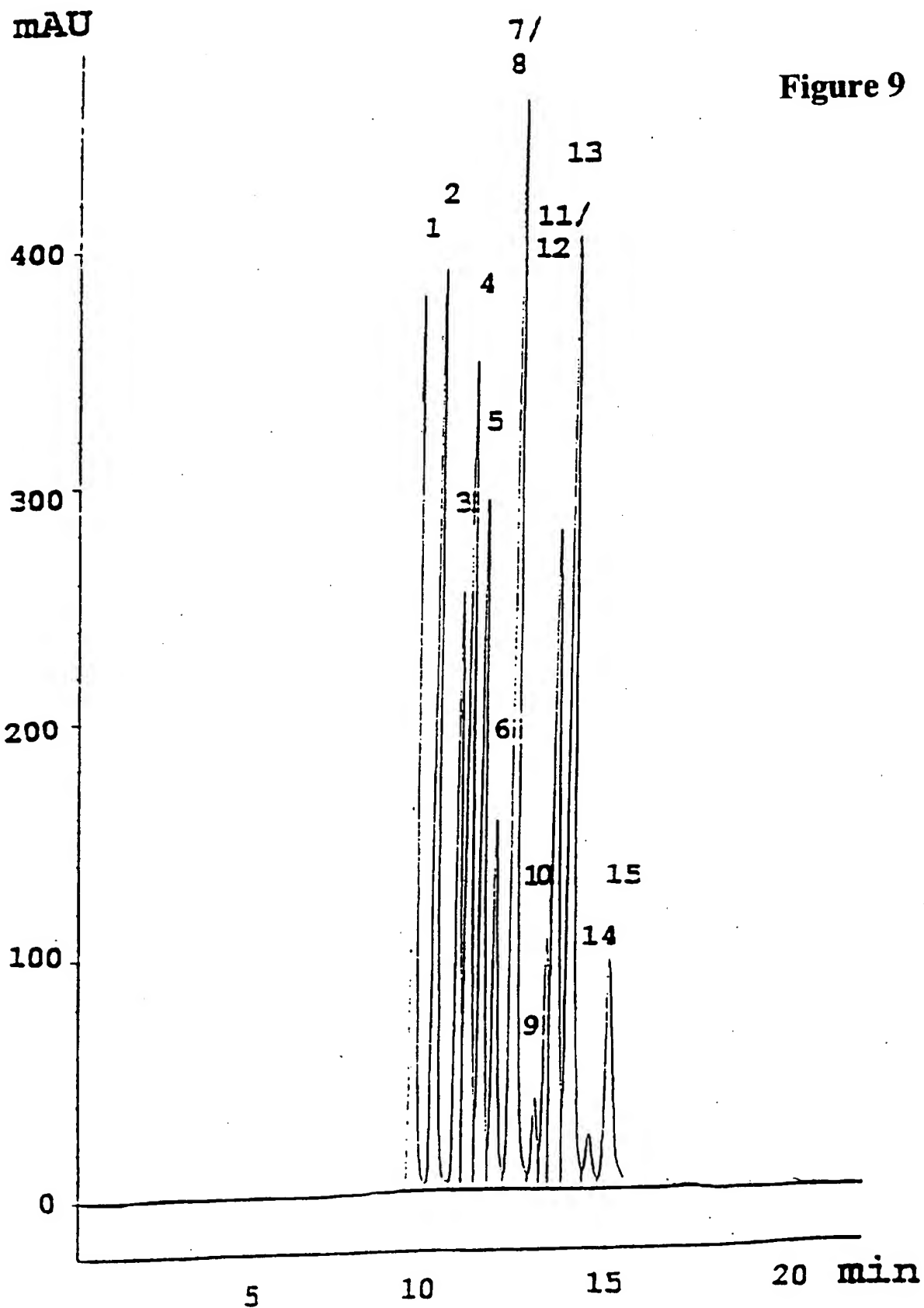


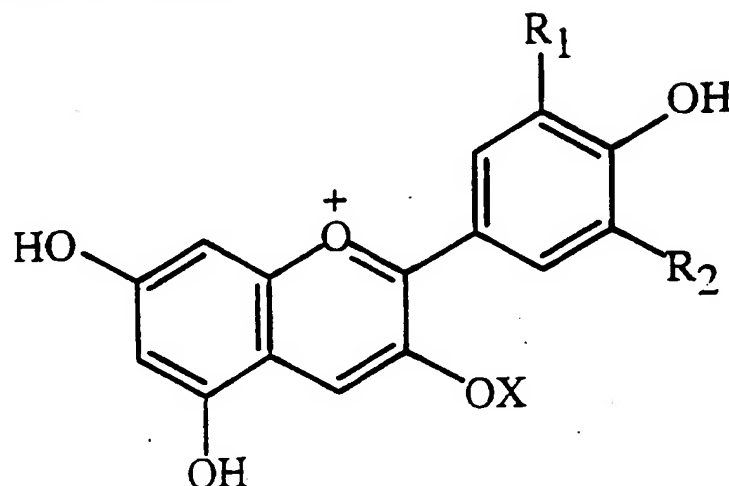
Figure 8

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Structures and relative proportions (%) of the individual anthocyanins in Sample II

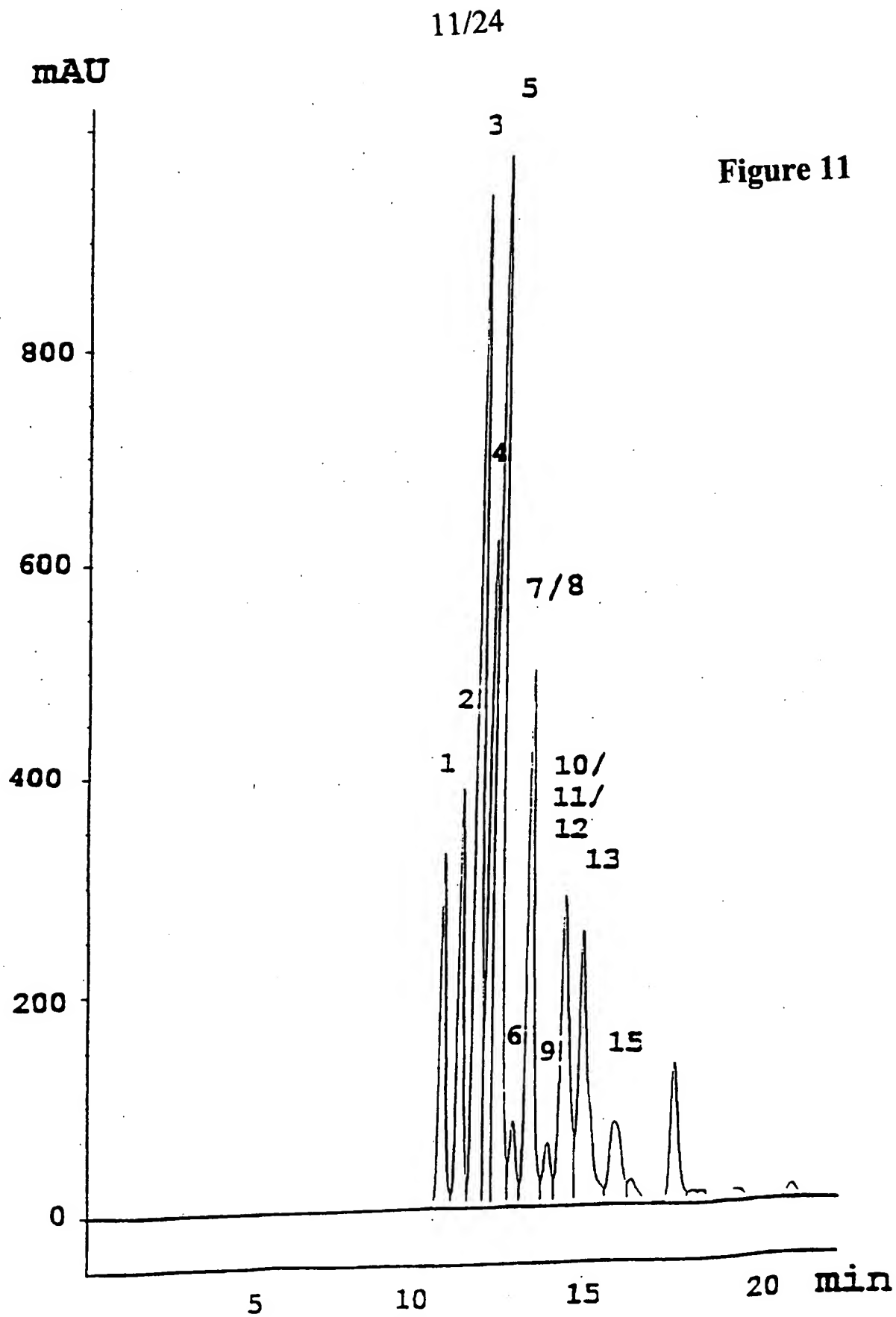


COMPOUND	R <sub>1</sub>	R <sub>2</sub>	X	(%)
1. Delphinidin-3-galactoside	OH	OH	galactose	10.6
2. Delphinidin-3-glucoside	OH	OH	glucose	10.7
3. Cyanidin-3-galactoside	OH	H	galactose	6.8
4. Delphinidin-3-arabinoside	OH	OH	arabinose	10.6
5. Cyanidin-3-glucoside	OH	H	glucose	8.1
6. Petunidin-3-galactoside	OCH <sub>3</sub>	OH	galactose	4.6
7. Cyanidin-3-arabinoside	OH	H	arabinose	*
8. Petunidin-3-glucoside	OCH <sub>3</sub>	OH	glucose	15.2*
9. Peonidin-3-galactoside	OCH <sub>3</sub>	H	galactose	1.2
10. Petunidin-3-arabinoside	OCH <sub>3</sub>	OH	arabinose	2.9
11. Peonidin-3-glucoside	OCH <sub>3</sub>	H	glucose	**
12. Malvidin-3-galactoside	OCH <sub>3</sub>	OCH <sub>3</sub>	galactose	10.3**
13. Malvidin-3-glucoside	OCH <sub>3</sub>	OCH <sub>3</sub>	glucose	14.1
14. Peonidin-3-arabinoside	OCH <sub>3</sub>	H	arabinose	0.9
15. Malvidin-3-arabinoside	OCH <sub>3</sub>	OCH <sub>3</sub>	arabinose	4.0

\* Pigment 7 and 8 together

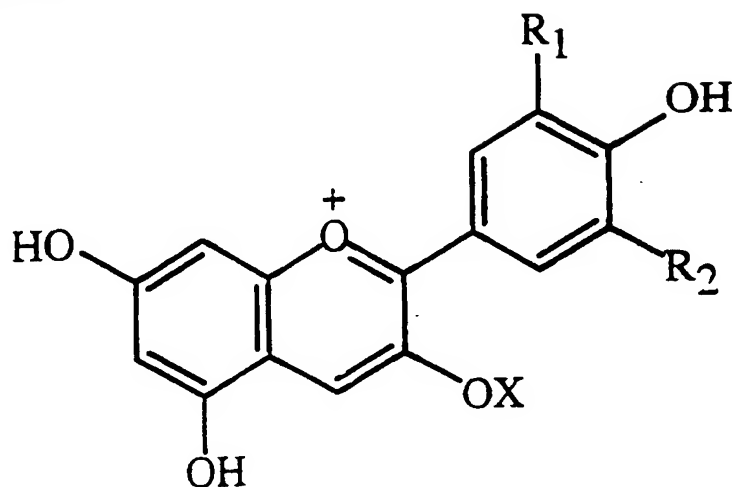
\*\* Pigment 11 and 12 together

**Figure 10**  
SUBSTITUTE SHEET (RULE 26)



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Structures and relative proportions (%) of the individual anthocyanins in Sample III



COMPOUND	R <sub>1</sub>	R <sub>2</sub>	X	(%)
1. Delphinidin-3-galactoside	OH	OH	galactose	6.4
2. Delphinidin-3-glucoside	OH	OH	glucose	7.4
3. Cyanidin-3-galactoside	OH	H	galactose	20.2
4. Delphinidin-3-arabinoside	OH	OH	arabinose	11.0
5. Cyanidin-3-glucoside	OH	H	glucose	22.8
6. Petunidin-3-galactoside	OCH <sub>3</sub>	OH	galactose	1.6
7. Cyanidin-3-arabinoside	OH	H	arabinose	*
8. Petunidin-3-glucoside	OCH <sub>3</sub>	OH	glucose	11.4*
9. Peonidin-3-galactoside	OCH <sub>3</sub>	H	galactose	1.2
10. Petunidin-3-arabinoside	OCH <sub>3</sub>	OH	arabinose	**
11. Peonidin-3-glucoside	OCH <sub>3</sub>	H	glucose	**
12. Malvidin-3-galactoside	OCH <sub>3</sub>	OCH <sub>3</sub>	galactose	8.5**
13. Malvidin-3-glucoside	OCH <sub>3</sub>	OCH <sub>3</sub>	glucose	7.4
14. Peonidin-3-arabinoside	OCH <sub>3</sub>	H	arabinose	trace
15. Malvidin-3-arabinoside	OCH <sub>3</sub>	OCH <sub>3</sub>	arabinose	2.1

\* Pigment 7 and 8 together

\*\* Pigment 10, 11 and 12 together

Figure 12

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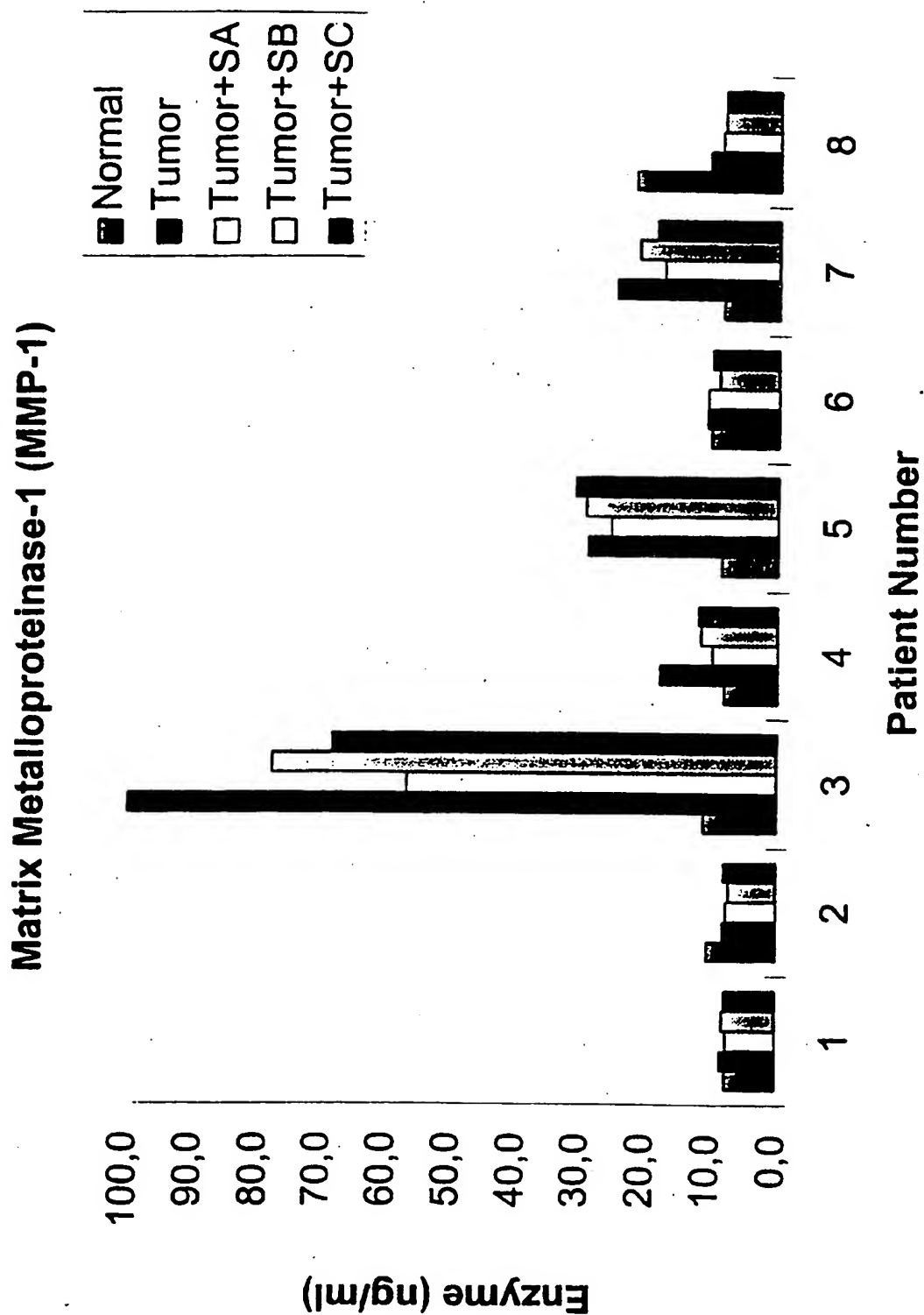


Figure 13

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Rectum

Tumour+SC Tumour+SB Tumour+SA Tumour

Normal+SC Normal+SB Normal+SA Normal

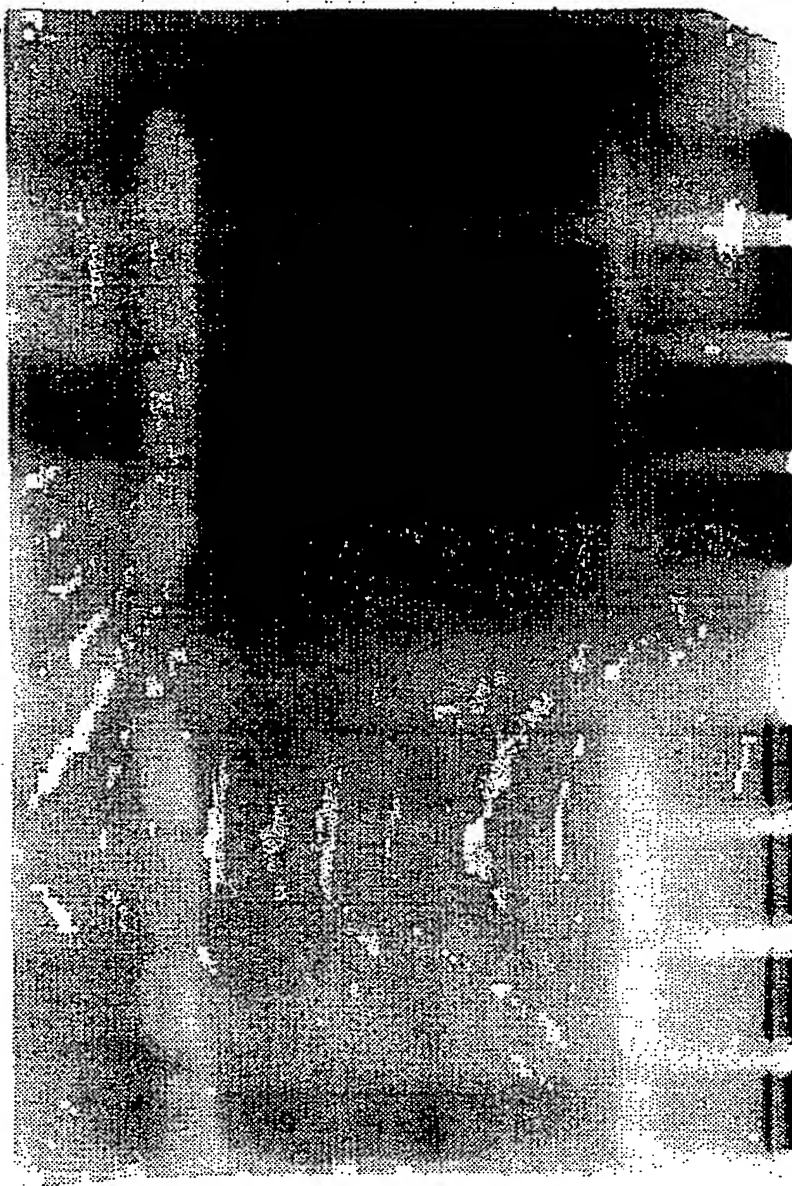
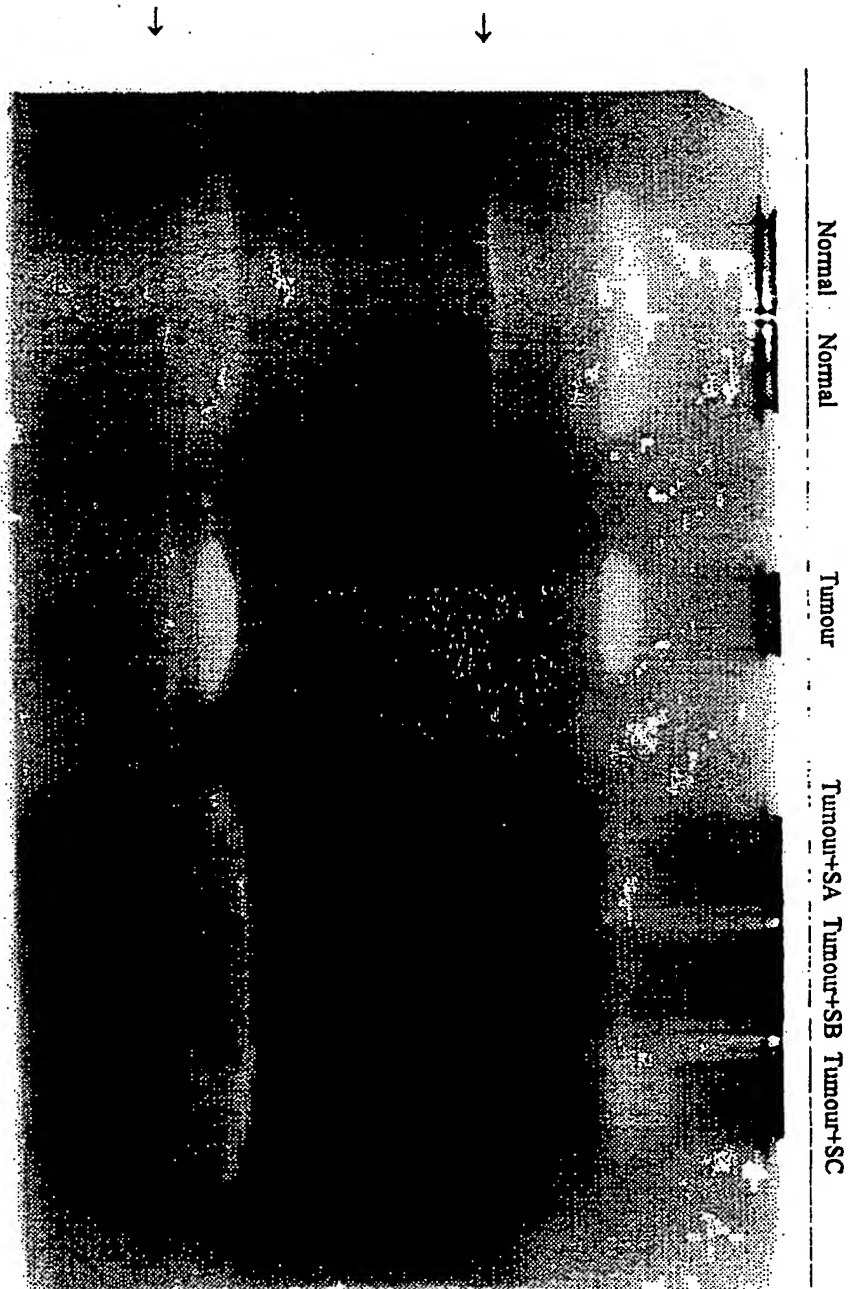


Figure 14

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Colon

Figure 15



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Ventricle



Figure 16

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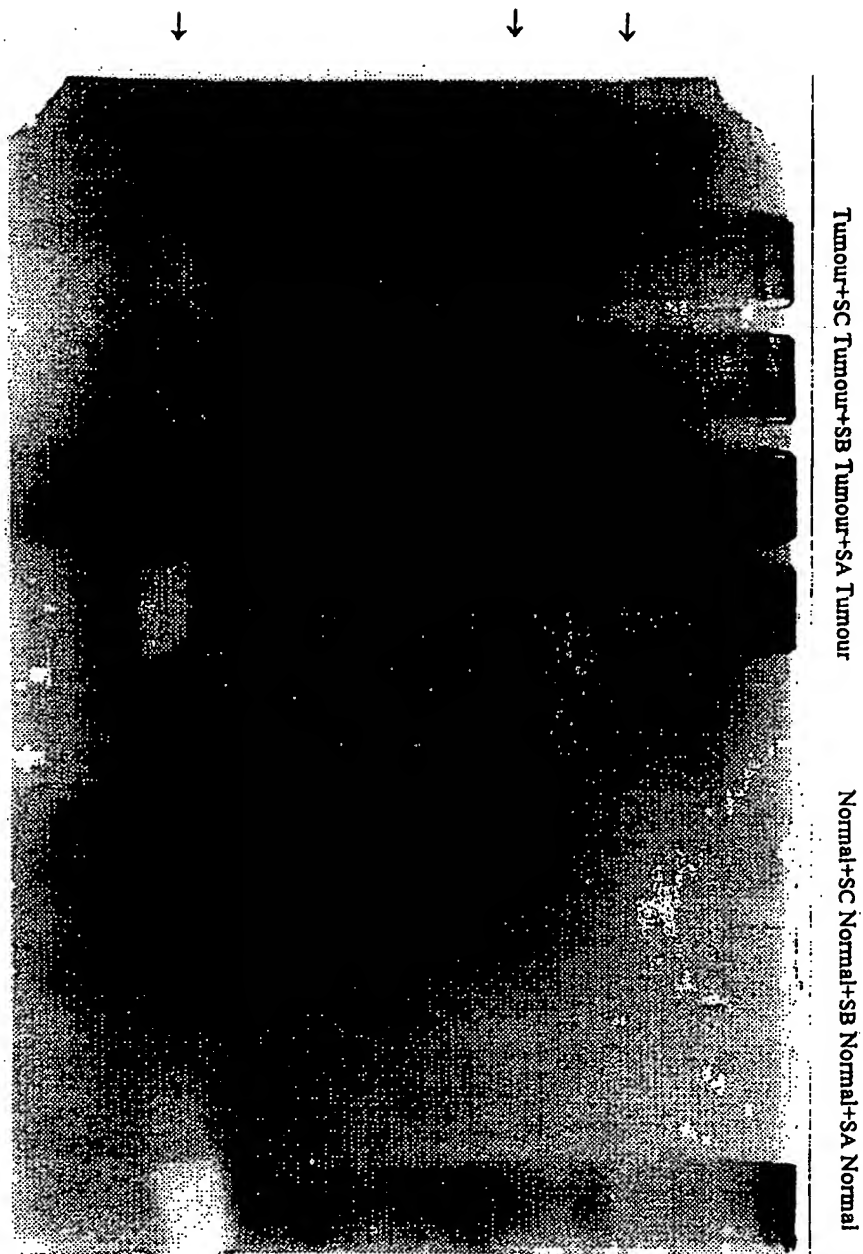


Figure 17

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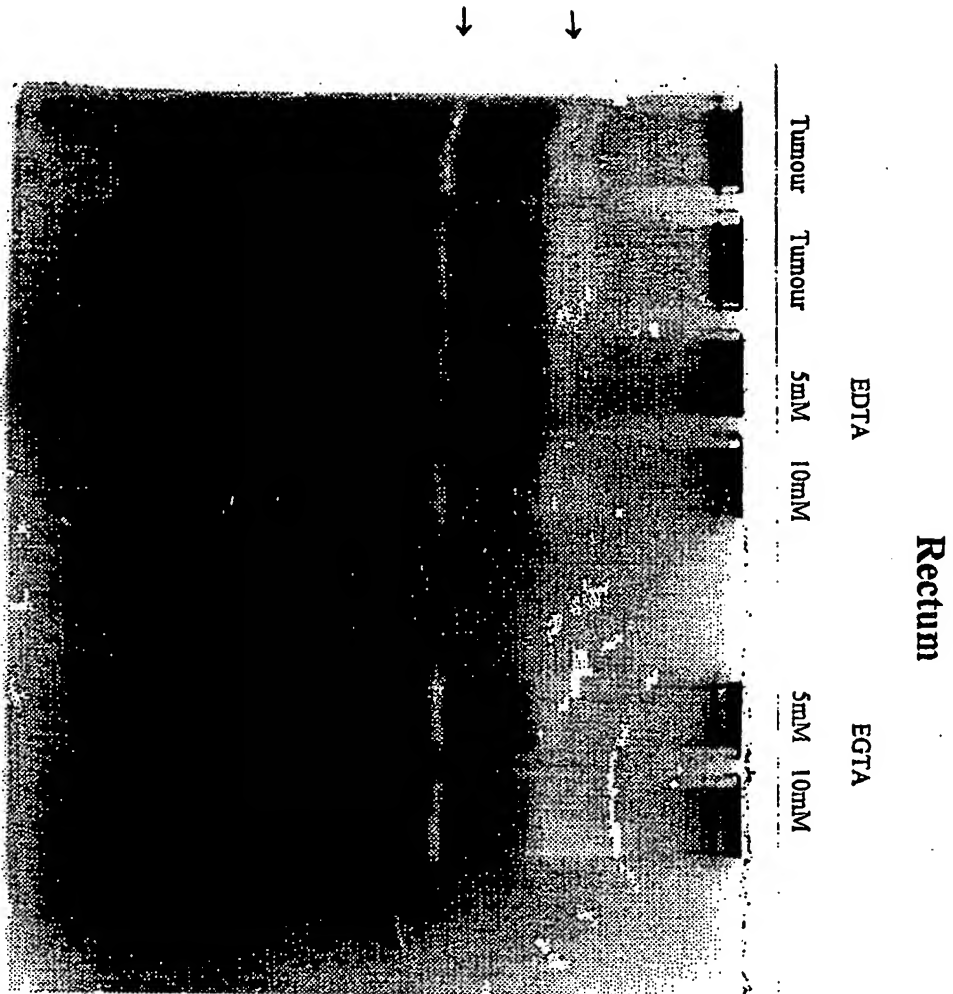


Figure 18

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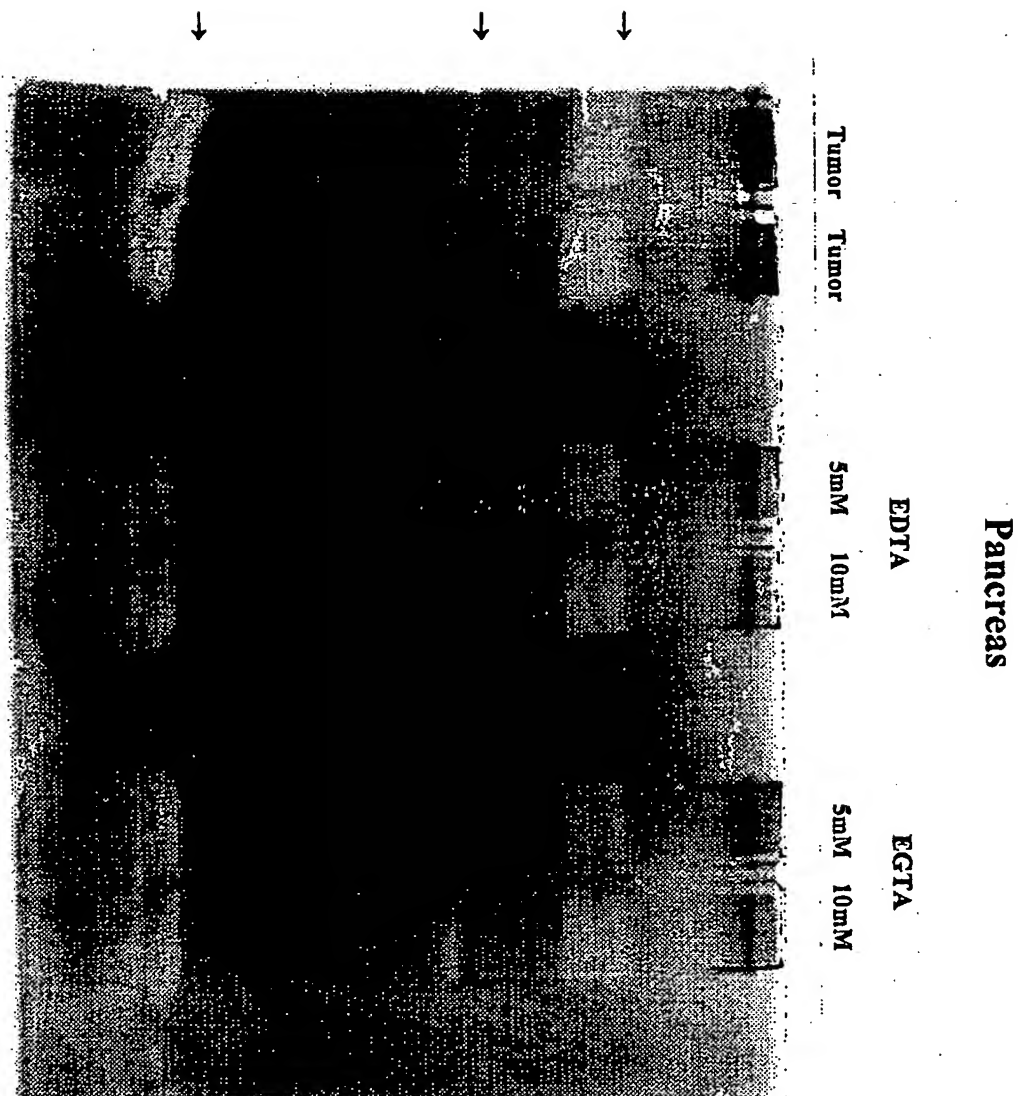
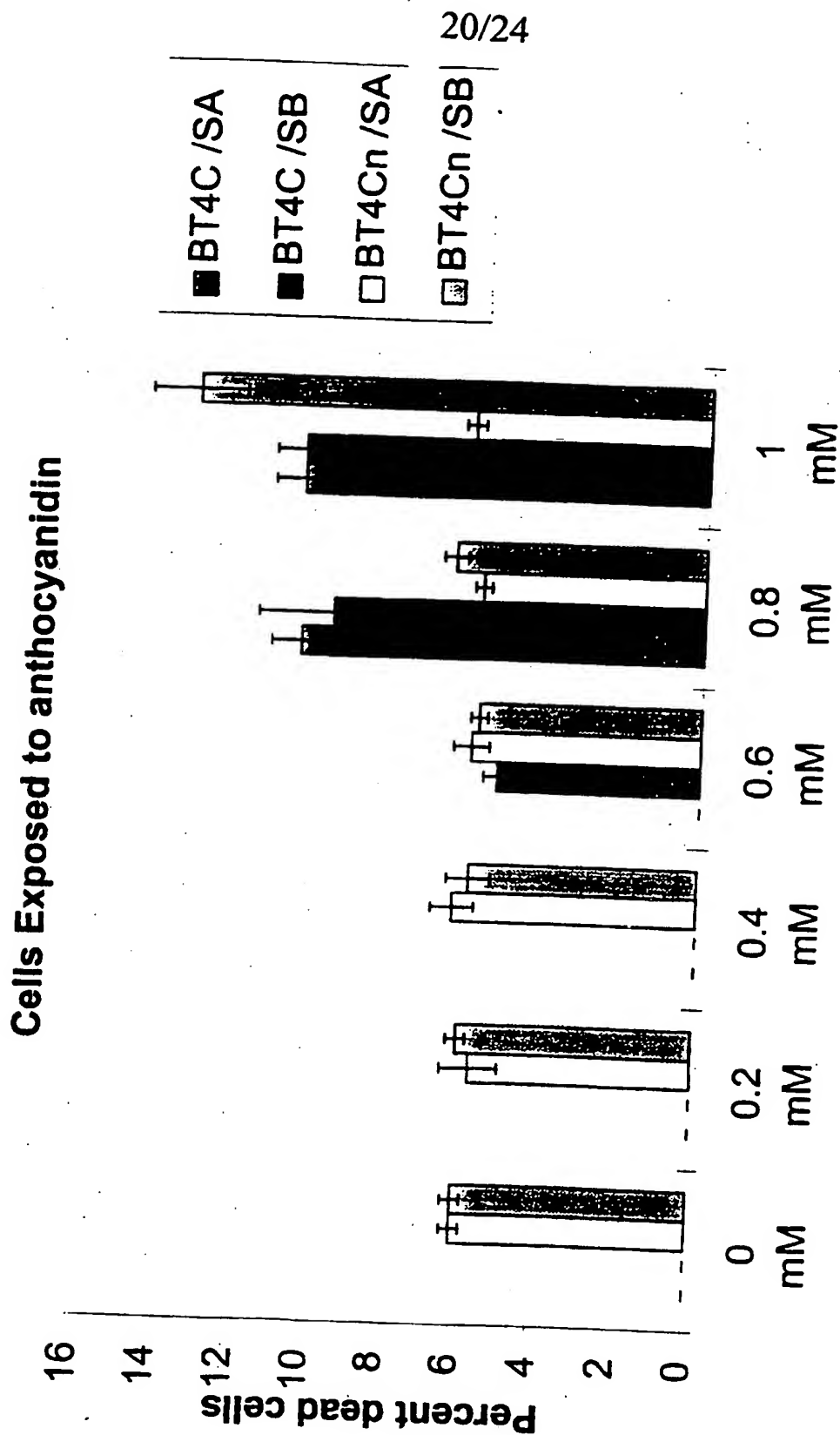
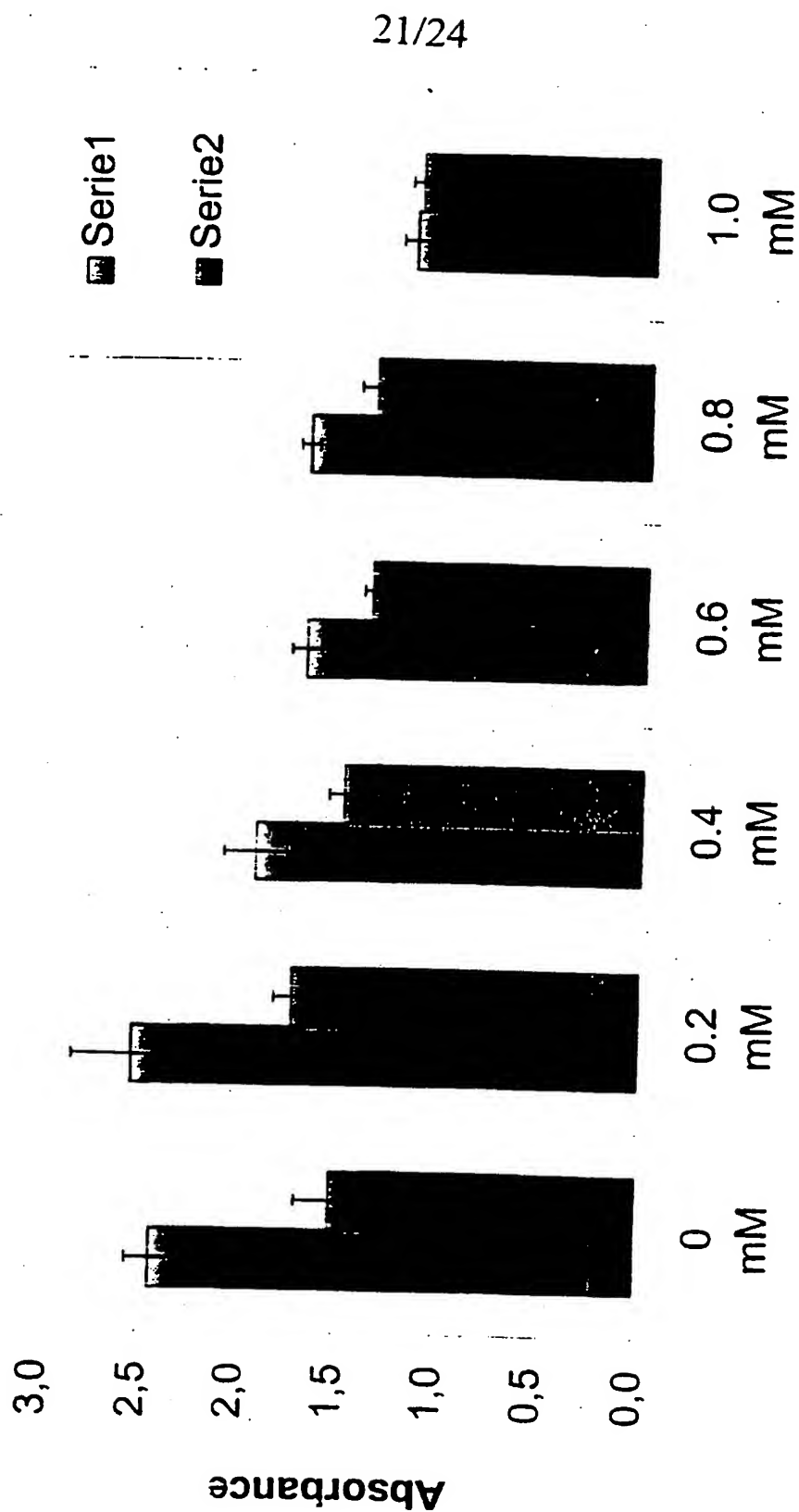


Figure 19



**Figure 20**

# Neutral Red Uptake in BT4C Cells



Final concentration of anthocyanidin

Figure 21

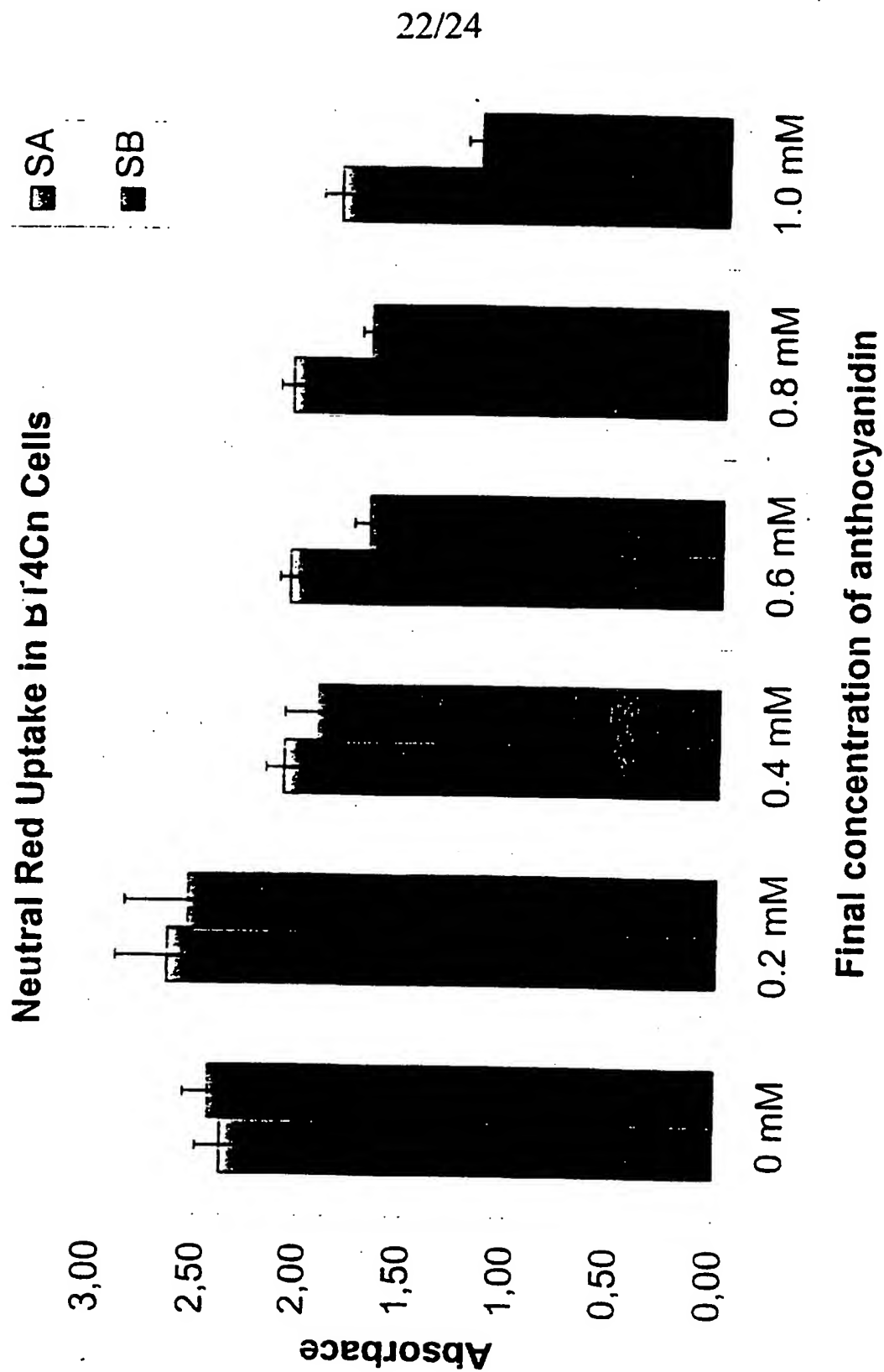


Figure 22

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Cells Exposed to SB3 for 24 Hours

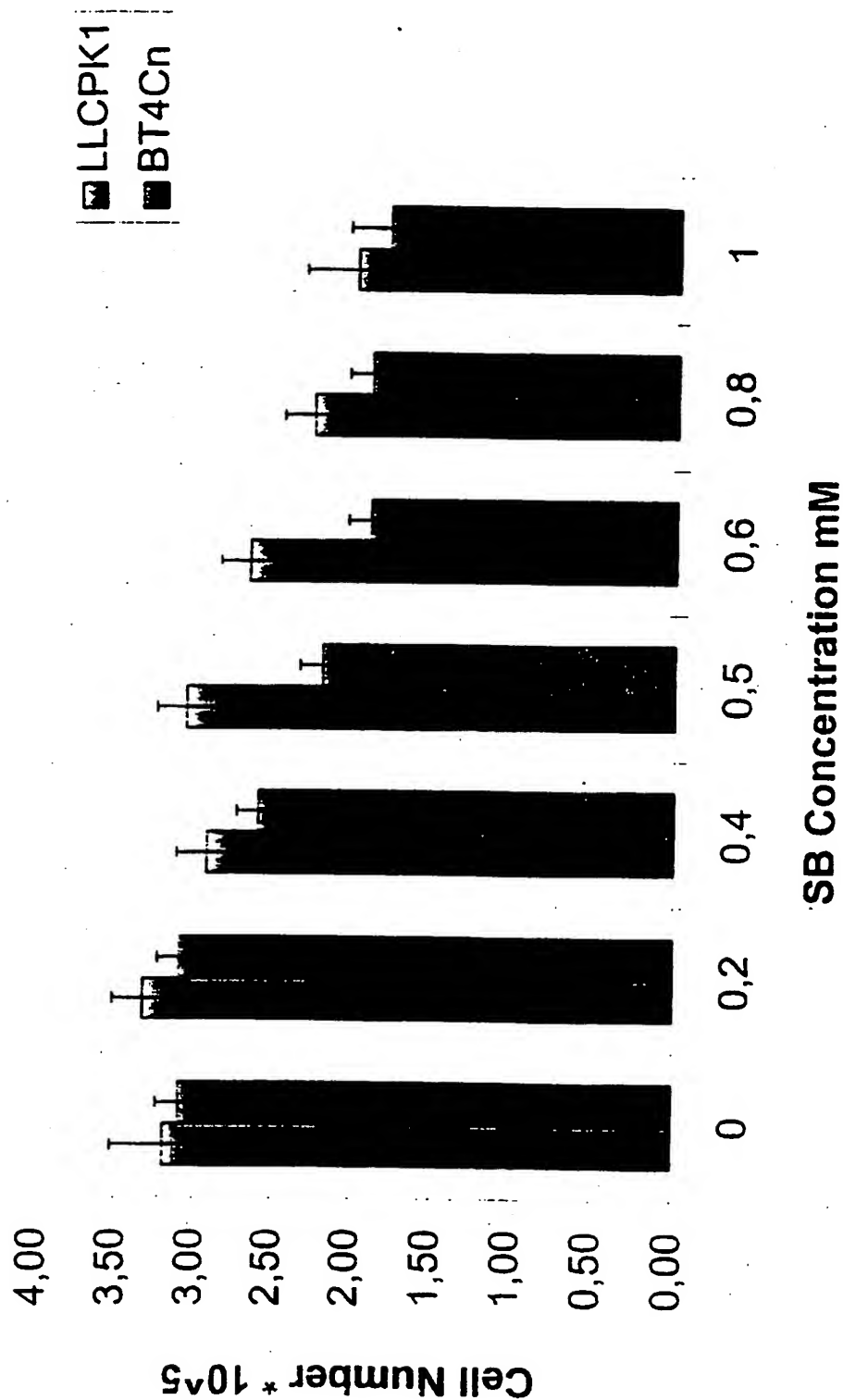


Figure 23



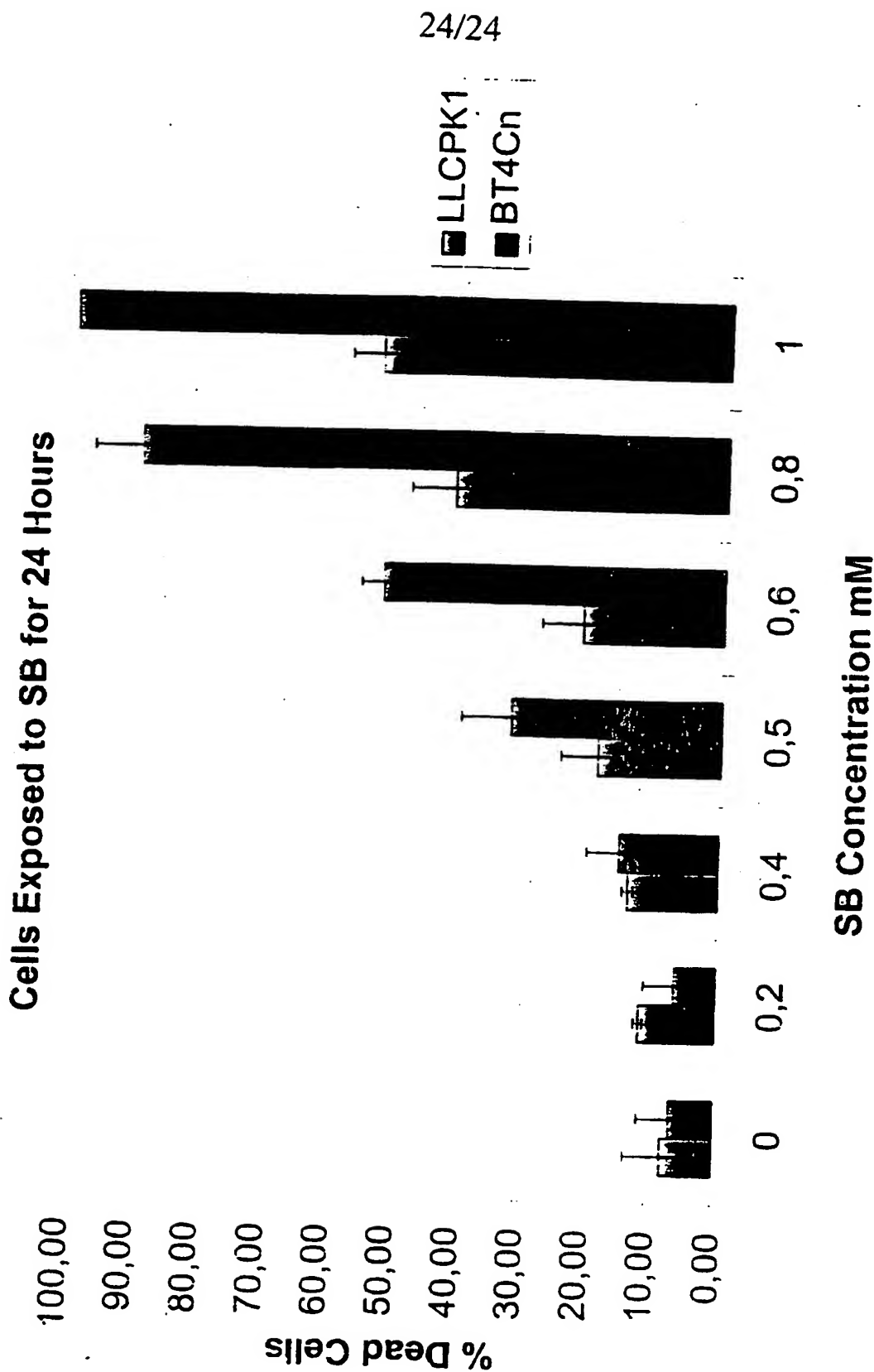


Figure 24

## INTERNATIONAL SEARCH REPORT

International Application No

PCT/NO 97/00100

A. CLASSIFICATION OF SUBJECT MATTER  
 IPC 6 C07H17/065 C07D311/62 A61K31/70

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 6 C07H C07D A61K

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	PATENT ABSTRACTS OF JAPAN vol. 015, no. 484 (C-0892), 9 December 1991 & JP 03 209321 A (TORAY IND INC), 12 September 1991,  see abstract	1-4,6-8, 10, 13-15, 19,22, 26,28, 32,33
X	PATENT ABSTRACTS OF JAPAN vol. 015, no. 484 (C-0892), 9 December 1991 & JP 03 209320 A (TORAY IND INC), 12 September 1991, see abstract	1-8, 13-15, 19,22,26
	--- -/--	

☒ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

## \* Special categories of cited documents:

- "A" document defining the general state of the art which is not considered to be of particular relevance
- "E" earlier document but published on or after the international filing date
- "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
- "O" document referring to an oral disclosure, use, exhibition or other means
- "P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search

16 September 1997

Date of mailing of the international search report

06-10-1997

Name and mailing address of the ISA

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 NL - 2280 HV Rijswijk  
 Tel. (+ 31-70) 340-2040, Tx. 31 651 epo nl,  
 Fax (+ 31-70) 340-3016

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# INTERNATIONAL SEARCH REPORT

International Application No  
PCT/NO 97/00100

## C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	PATENT ABSTRACTS OF JAPAN vol. 015, no. 484 (C-0892), 9 December 1991 & JP 03 209319 A (TORAY IND INC), 12 September 1991, see abstract	1-5,12, 15,19, 22,26
X	--- PATENT ABSTRACTS OF JAPAN vol. 006, no. 214 (C-131), 27 October 1982 & JP 57 120584 A (KANEBO KK), 27 July 1982, see abstract	1,9
X	--- PATENT ABSTRACTS OF JAPAN vol. 006, no. 214 (C-131), 27 October 1982 & JP 57 118580 A (KANEBO KK), 23 July 1982, see abstract	1,9
X	--- PATENT ABSTRACTS OF JAPAN vol. 005, no. 067 (C-053), 7 May 1981 & JP 56 016412 A (KANEBO LTD), 17 February 1981, see abstract	1,9
X	--- PATENT ABSTRACTS OF JAPAN vol. 017, no. 052 (C-1022), 2 February 1993 & JP 04 264027 A (TAIYO KAGAKU CO LTD), 18 September 1992, see abstract	1,9
A	--- EP 0 412 300 A (INVERNI DELLA BEFFI S.P.A) 13 February 1991 see column 3; examples	1,24,25, 31
A	--- US 4 999 423 A (EIICHI IDEKA) 12 March 1991. see claims	15-19, 22,23
P,X	--- WO 96 11692 A (UNIFOB STIFTELSEN UNIVERSITETSFORSKNING BERGEN) 25 April 1996 see the whole document	1,28,32
P,X	--- PATENT ABSTRACTS OF JAPAN vol. 096, no. 008, 30 August 1996 & JP 08 104628 A (SUMITOMO PHARMACEUT CO LTD), 23 April 1996, see abstract	1,11,28, 32
	-----	

# INTERNATIONAL SEARCH REPORT

International application No.

PCT/NO 97/00100

## Box I Observations where certain claims were found unsearchable (Continuation of item 1 of first sheet)

This International Search Report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☒ Claims Nos.:  
because they relate to subject matter not required to be searched by this Authority, namely:  
Remark: Although claim(s) 32 and 33  
is(are) directed to a method of treatment of the human/animal  
body, the search has been carried out and based on the alleged  
effects of the compound/composition.
2. ☐ Claims Nos.:  
because they relate to parts of the International Application that do not comply with the prescribed requirements to such  
an extent that no meaningful International Search can be carried out, specifically:  
Claims 27, 30, 31  
See annex
3. ☐ Claims Nos.:  
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

## Box II Observations where unity of invention is lacking (Continuation of item 2 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

1. ☐ As all required additional search fees were timely paid by the applicant, this International Search Report covers all  
searchable claims.
2. ☐ As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment  
of any additional fee.
3. ☐ As only some of the required additional search fees were timely paid by the applicant, this International Search Report  
covers only those claims for which fees were paid, specifically claims Nos.:
4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this International Search Report is  
restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

- ☐ The additional search fees were accompanied by the applicant's protest.  
☐ No protest accompanied the payment of additional search fees.

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

Claims Nos.: 27,30,31

because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

The scope of the independent claim 27, and thus also the dependent claim 30 and 31 cannot be determined, since they are defined (limited) by reference to a number of non patent publications, the contents of which (in particular compounds disclosed therein) form a disclaimer to said claims. As such, it is the opinion of the ISA (Art. 17 PCT) that a meaningful search cannot be performed for these claims.

# INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No

PCT/NO 97/00100

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
EP 412300 A	13-02-91	AT 130305 T	15-12-95
		CA 2022962 A	12-02-91
		DE 69023569 D	21-12-95
		DE 69023569 T	18-04-96
		ES 2080769 T	16-02-96
		JP 3099090 A	24-04-91
		US 5200186 A	06-04-93
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US 4999423 A	12-03-91	CA 1326019 A	11-01-94
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WO 9611692 A	25-04-96	AU 3756995 A	06-05-96
		EP 0785790 A	30-07-97
		FI 971459 A	05-06-97
		NO 971573 A	09-06-97
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